Aalto University
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IMPROVING LARGE AND ESTABLISHED INDUSTRIAL ORGANIZATIONS' INNOVATION CAPABILITY THROUGH INNOVATION BARRIERS AND INNOVATION CULTURE

A Structural Equation Modeling approach

Master's Thesis
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Abstract of master's thesis

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Innovation is essential for large and established business organizations. To remain competitive in the ever-pacing rivalry, organizations must be capable of innovating, but also beyond the traditionally thought areas such as products. One key element to support continuous innovation and renewal is contributable to a specific form of organizational capability, innovation capability. However, given that only a handful of all Fortune 500 companies prevail compared to past 100 years, the findings suggests that many companies are underperforming in their innovation activity. As current literature has mainly focused on innovation enablers, this thesis aims to explore the effects of various barriers that inhibit, block, or delay innovation in one industrial organization. Based on the findings of the study, the thesis proposes a novel framework for future research purposes: organizational structures, leadership, culture, and people enable innovation structurally, but which still need specific managerial capabilities to overcome potential limiting factors. The thesis surveyed 192 organizational members within one established high-technology industrial organization across two hierarchical layers - managers with staff responsibilities and employees. Studying the structural relationship of innovation barriers and innovation capability provides managers theoretical understanding how to enhance organizations innovation capability by accounting the perceptions and experiences of its organizational members through barrier perspective. Factor Analysis was performed to reveal underlying latent barrier constructs. The results suggest that two major barrier constructs negatively affect innovation in the studied organization. For employees, barriers that related to organizational focus and management were found to carry a statistically significant and negative effect on innovation capability. Respectively managers with staff responsibilities perceived that resources, incentives, and current innovation process affect negatively innovation capability. The results suggest that managers of the studied organization may be limited due higher-order organizational constraints or managerial capabilities – and that employees expect different kind of management and leadership approach for innovation than it is for current. The findings of this study help to understand the nature of innovation barriers and innovation culture, and their influence mechanism on innovation capability. From theoretical perspective, the thesis confirmed the commonly found claim that innovation culture has positive effect on innovation capability, but the thesis further proposes that certain cultural traits might reduce the negative effect of barriers through moderating effect.

Keywords Innovation, Innovation Development, Innovation Barriers, Innovation Culture, Innovation Capability, Dynamic Capabilities, Structural Equation Modeling, SEM

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Innovaatio on välttämätöntä suurille ja vakiintuneille yritysorganisaatioille. Organisaatioiden on kyettävä innovoimaan, mutta ei vain ainoastaan tuotteissa. Yksi avaintekijä jatkuvan innovoinnin tukemisessa on innovaatiokyvykkyyden kasvattaminen. Yritysten innovatiivisuuden puutetta ei voida selittää ideoiden puuttumisella, mikä viittaa siihen, että monet yritykset ovat menestyneet toteutuksessa huonosti, kun otetaan huomioon, että Fortune 500 -yrityksistä vain kourallinen yrityksiä on jäljellä verrattuna viime 100 vuoteen. Koska nykyinen kirjallisuus on keskittynyt pääasiassa innovaatioiden mahdollistajiin, tämän tutkielman tarkoituksena on tutkia erilaisten esteiden vaikutuksia, jotka viivästyttävät innovaatioita. Opinnäytetyössä ehdotetaan uutta viitekehystä tulevaisuuden tutkimustarkoituksiin: organisaatiorakenteet, johtaminen, kulttuuri ja ihmiset mahdollistavat innovoinnin, mutta tarvitsevat johdon tukea innovaatiokykyyn vaikuttavien esteiden poistamiseksi. Opinnäytetyössä kartoitettiin yhteensä 192 organisaation jäsentä yhdestä vakiintuneesta korkean teknologian teollisuusorganisaatiosta kahdessa hierarkkisessa kerroksessa. Työn tarkoituksena on heijastaa eroja taustalla olevista käsityksistä, jotka mahdollisesti rajoittavat tutkitun yrityksen innovaatiokykyä. Tutkimus tehtiin faktorianalyysillä, joka paljastaa taustalla olevat piilevät esterakenteet ja niiden vaikutukset. Tuloksena havaittiin, että kaksi suurta esterakennetta vaikuttavat negatiivisesti innovaatiokyvykkyyteen ryhmien välillä. Työntekijöiden kannalta esteiden havaittiin liittyvän organisaation suuntautumiseen ja johtamiseen liittyviin tekijöihin. Vaikutukset olivat tilastollisesti merkitseviä ja innovaatiokykyä heikentäviä. Vastaavasti johtajien mielestä organisaatiosta johtuvat tekijät, kuten resurssit, kannustimet ja nykyinen innovaatioprosessi vaikuttivat negatiivisesti innovaatiokykyyn. Tulokset viittaavat siihen, että johtajat ja työntekijät näkevät erilaisten esteiden vaikutukset eri tavoin, ja että vaikutukset ovat erisuuruisia. Näkökulmaero auttaa ymmärtämään kunkin roolin kautta mahdollisia ongelmien juurisyitä: työntekijät odottavat vahvempaa innovaatiojohtajuutta, ja johtajat saattavat olla rajoittuneita organisaatiosta johtuvien tekijöiden takia. Opinnäytetyössä testattiin myös sitä, olisiko yhdellä innovaatiokirjallisuudessa mainitulla mahdollistajalla, innovaatiokulttuurilla positiivista vaikutusta innovaatiokykyyn. Innovaatiokulttuuriin liittyvien muuttujien havaittiin olevan tilastollisesti merkitseviä ja vaikuttavan positiivisesti innovaatiokykyyn molemmissa mitattavissa ryhmissä. Tutkimuksessa testattiin myös innovaatiokulttuurin mahdollisia moderaatiovaikutuksia, ja todettiin, että vahvan innovaatiokulttuurin vallitessa joidenkin esteiden vaikutus innovaatiokyvykkyyteen vähenee. Tämän tutkimuksen tulokset auttavat ymmärtämään innovaatioiden esteiden luonnetta ja niiden vaikutusmekanismia innovaatiokykyyn. Innovaatioesteiden ja innovaatiokyvyn rakenteellisen suhteen tutkiminen antaa johtajille paremman teoreettisen ymmärryksen siitä, kuinka organisaation innovaatiokykyä voidaan parantaa ottamalla huomioon organisaation jäsenten käsitykset ja kokemukset.

Avainsanat Innovaatio, Innovointi, Innovaation esteet, Innovaatiokulttuuri, Innovaatiokyvykkyys, Dynaamiset kyvykkyydet, Rakenneyhtälömalli

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After countless of hours (really), the thesis is finally packed with my best ability. The thesis would neither have been possible without the support of colleagues at work, and additional gratitude belongs to Päivi K. and K-M. Vakkala for reviewing the survey items relevance. Further, thanks Matti K. for sponsoring my thesis. Thank you Risto L. for acting as a good listener and fair and understandable co-worker. I hope that the results of the thesis will be used for developmental purposes and that the findings would awake insights not from theoretical point of view, but also from practical as well.

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1. Introduction

Over the last few decades, innovation appears to have become one of the main driving forces of companies' competitiveness and success. Innovating companies grow faster, have higher productivity, and are more profitable than their less innovative counterparts (Yannopoulos, Gorish, Kefalaki, 2011). This activity is increasingly seen as a managed discipline rather than occasional breakthrough activity (Drucker, 2002) where enhancing organizations' *innovation capability* has become one major organizational goal to gain advantage over competitors (Breznik & Lahonovik, 2012).

In response, innovation has received much reverential rhetoric in companies' internal and external communications. However, a broad survey made to 850 senior executives across the globe reveals that this rhetoric has broadly failed to deliver concrete actions. While 66 % of the respondents were concerned that their organization would not survive without innovation, a large share of them (37 %) has made little or no changes into their innovation approach; only 24 % had defined the skills they need to be innovative; and only 50 % believed that their leaders are displaying the vision and passion needed to make innovation happen. (PA Consulting, 2017). These findings suggest that many organizations' capability to innovate and renew might be limited due either managerial ignorance, conflicting priorities, mismanagement, or deficit leadership skills. However, modern industrial companies are under increasing pressures to tune their innovation capability as competition in high-technology industries is pacing up within innovation economy. For example, commoditization for high-technology products has been found accelerating (Shih, 2018) while customers' demands are at all-time high: customers expect seamless journeys, customization, and more frequent product innovation (Salesforce, 2019).

Companies' ability to match these new standards must be researched from the perspective "*what hampers innovation"* (D'este, 2012). Because lack of innovation is not due lack of innovative ideas but more of their implementation (Pinchot, 1985), the finding suggest major rooms for improvement. However, current innovation literature has mainly focused on innovation enablers rather than looking at the limiting factors of organizations. Another viable research stream to enhance *innovation capability* is to explore the organizational contingencies, such as leadership and management practices, use of resources, organizational structures, processes and tools, organizational learning and culture that potentially hamper innovation (Hueske et al. 2014). Until recent years, research on these

limitations, *innovation barriers*, has gained relatively little emphasis among scholars or practitioners (Hueske, 2014; Hueske et al. 2015). For example, research has produced only a few relevant theoretical frameworks that describe the potential sources of innovation barriers, and research has completely lacked empirical studies on the specific effects of the categorized barriers on innovation capability. In addition, as research has identified that certain cultural traits are beneficial to innovation, research has lacked explanations on the mechanism how exactly culture is beneficial to innovative performance. This research aims to address the mentioned gaps in literature by exploring the roles and effects of innovation barriers and innovation culture on innovation capability. Altogether 192 respondents' survey data of one large and established, multinational company operating in high-technology industry was analyzed with Structural Equation Modeling (SEM). The analysis accounted two different hierarchical roles (managers with staff, employees) that are seen to reflect different perceptions of reality due their expected roles. The method allowed exploring structural relationships and their effects between and various innovation-related concepts, and gaining insight about the mechanisms through which innovation capability can potentially be enhanced.

The thesis suggests that the best-performing organizations are able critically evaluating their underlying structures, management styles, core and support processes along with the underlying organizational culture in order to improve their capability to innovate and renew. For this purpose, barrier research enacts as the basis for identifying various issues that limit innovation, and can be viewed as the first although initial step for aligning organizations better with innovation goals.

1.1. Research objectives

The study aims to answer on the call for more innovation barrier research that has remained relatively unstudied field through the years (Hueske et al. 2014; Hueske, 2015). The study examines how one key enabler to innovation – innovation culture – and innovation barriers are interrelated by analyzing their structural effects on innovation capability across two measured hierarchical groups. The distinction is made to reflect differences between the measured groups and to reveal possible root causes of potential limiting factors to innovation in the studied organization. The effects are examined empirically by surveying one industrial organization and by performing factor analysis and regression analyses. Following research questions are drawn:

1) **What are the effects of various innovation barriers on innovation capability in the studied organization?**
2) **Are the effects (size, direction or significance) dependent on the hierarchical role?**
3) **What is the underlying mechanism according to which innovation culture positively affect innovative performance?**

To date, research has not been explicit in specifying the elements that affect innovation capability both positively and negatively, and neither in verifying their influence mechanisms. For example, research acknowledges that various *innovation barriers* (part 4) limit, inhibit, or block innovation, but their effect and significance has remained completely unexplored. Furthermore, research has not produced any empirical research how various organizational hierarchies perceive the effects of barriers. In addition, numerous culture-performance studies have settled for a vague finding that culture has direct and positive effect on innovation (Hilmarsson et al. 2011), but the potential mediating and moderating effects have remained somewhat unexplored (Zhang et al. 2018). Thus, the research tests a possible mechanism how certain cultural traits, such as innovation culture, can be beneficial in improving companies' innovation capability. For this purpose, the study proposes also a novel framework through which organizations' innovation capability can potentially be enhanced.

1.2. Structure of the thesis

The thesis has nine chapters. In chapter one, the rationale for the thesis is presented; innovation has received a lot of reverential rhetoric in companies' communications, but many companies have made little or no changes to their innovation approach (PA, 2017). This calls for examining innovation from barrier perspective: what hampers innovation, and what can be done to enhance organizations' innovation capability? In chapter two, the ongoing challenge for companies is introduced: the pace of change is *accelerating* whereas organizations are argued to be capable of transforming themselves only at a logarithmic scale when compared to the pace of development and change. Then, a view to current paradigms regarding innovation is made by addressing that many companies are not well-aligned with common definition for innovation. Further, different *forms* and *types* of innovation are revisited: many companies tend to limit narrowly into product innovation, and within two

types of innovation – radical and incremental. Chapter three provides the necessary theoretical background on what organizational capabilities are needed for innovations, and what kind of organizational constructs and characteristics contribute to innovation positively: innovation is enabled by certain organizational constructs, such as *visionary leadership capabilities, innovation culture, people and assets, tools and processes* that translate ideas into value through specific managerial capabilities - dynamic capabilities. The chapter provides also a review on the potential sources of innovation barriers by presenting EOGI barrier model to innovation (Hueske et al. 2014), in which potential innovation barriers can arise from *external, organizational, group, and individual level* factors. These enabling factors and barriers form the body for survey questions for the study (Appendix D). Chapter five describes how the found constructs relate to innovation capability and explains the methodology for the thesis. In chapter six, the findings of the study are presented. Chapter seven discusses on the findings both from theoretical and practical point of view. Chapter eight concludes the thesis, and chapter nine discusses on the limitations of this single case study.

2. Innovation matters

In *innovation economy,* companies' competitive advantage is becoming increasingly dynamic. For example, the number of product variants have been found to be increasing while their development time is decreasing. (E.g. Shih, 2018; Wiggins & Ruefli, 2005) Consequently, as "more" needs to be produced at less time, companies can maintain their competitive advantage for shorter periods. This pattern push business organizations to maintain their competitive position by improving their innovation capability, i.e. the ability to transform idea into something that carries economic value (Breznik & Lahonovik, 2012). In this goal, one fundamental task is to first establish common definition for innovation (part 2.2), understand different forms (part 2.3) and types (2.4.) of innovation.

2.1 The challenge: Accelerating change

An analysis of historical pace of technological development reveals that the likely course of technological change is closer to exponential rather than being linear (Kurzweil, 2005, p. 25). *The law of accelerating returns* has been [observed] for instance through Moore's law[1], and that the rate of change in a wide variety of evolutionary systems (including but not limited to technologies) tends to increase exponentially. (Kurzweil, 2005, p.26). Although some have argued that we are approaching the limits of growth in certain areas (e.g. in the number of transistors in condensed circuits), others argue that the pace of change will continue accelerating elsewhere (such as in nanotechnology) driving for further improvements.

According to Hilmarsson et al. (2011), increased transparency and availability of information will push pacing development within the Internet era. Furthermore, Shih (2018) argues that three other global phenomena interfere with it: (1) blatant copying of intellectual property (IP), (2) governments pressuring companies to share technology in exchange for rights to do business, and (3) knowledge spillover as workers move from multinationals to local companies influence. (Shih, 2018) A major challenge for large and established companies is hence that as they are commonly depicted rigid and slow, the external requirements are increasing exponentially. In his blog post, Brinker (2016) brings up the idea that the slowness cause organizations to be capable of changing at a logarithmic scale when compared to the exponential pace of development (Brinker, 2016). This view is

[1] The number of transistors in a dense circuit doubles about every two years.

compelling, because it addresses one theoretical foundation how successful companies might fail; it takes time for people (and their organizations) to alter their thinking and behavior, and the gap between external development and organizational change widens by time (Fig. 1).

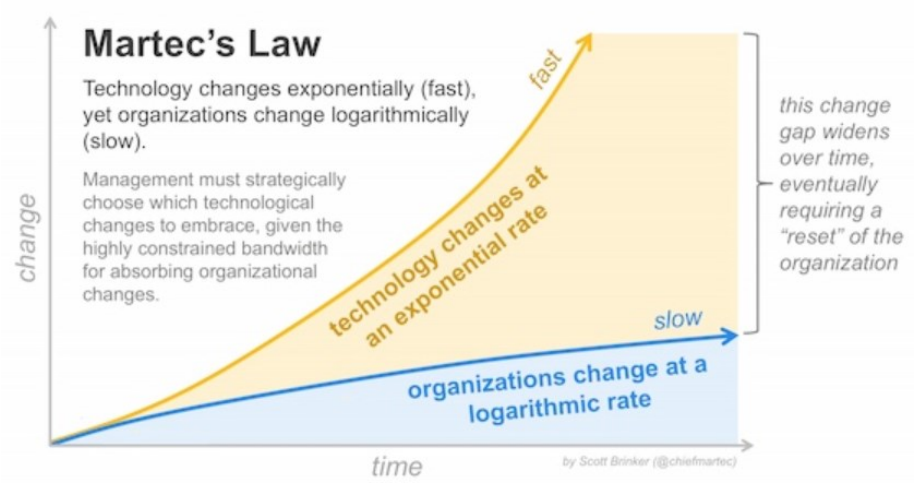


Figure 1. *Martec's Law (Brinker, 2016)*

Although the argument for accelerating change remains disputed (e.g. Tuomi, 2003), Martec's Law can serve as a useful framework where organizations *should* aim at with their innovation capability: if the pace of change is accelerating, innovation and adaptability are becoming the new source of competitive advantage (Reeves & Deimler, 2011). However, with best to the knowledge, this idea of a theoretical "gap" has not been noted in prior academic studies despite its evident usefulness for practice. Notwithstanding, the theory of poor ability to change is supported by historical examination of Fortune 500 companies, which reveals that 89 % have vanished compared to 1955 (Perry, 2018). This suggests that the gap between current capabilities and required capabilities has fallen short of what is required for the vast majority of companies through the history. Hence, to match the required speed with innovative outcomes, companies need to increase the *rate of change* by breaking down various innovation barriers by starting to critically evaluating their current practices.

2.2 Innovation

Innovation economy posits *innovation or death* – whether it concerns new outcomes (e.g. products, services, and technologies) or means through sustainable value is created (e.g. processes, ways of working, business models). Through the history, the definition of

innovation has remained by defining it through inventions: innovations are the outcomes that *are new to the world*, not obvious solutions, where creativity and expertise contribute. However, increasingly many scholars state that an invention to become an innovation requires carrying substantial economic value but which necessarily does not require technical inventions. Thus, newer definitions have started to appear which have increased the scope of innovations. These definitions challenge not only the definition of complete novelty but also how economic value is created. I argue that embracing a broader scope for innovation would help to manage one's competitiveness because it provides definition for the outcomes and activities that increase one's competitiveness *sustainably*.

According to Hilmarsson et al. (2011), innovation in many companies has been mainly associated with new product development [especially radical] and development of new processes. That view has recently slowly been changing, and innovation is widely seen to relate any part of the value chain, whether developing new services, new business models, rethinking cooperation, revenue streams, distribution channels, or management styles (Hilmarsson et al. 2011). In addition, besides conceiving innovations through research and development, innovations can also be adopted (Damanpour & Gopalakrishnan, 1998). Such examples could be new philosophies and ways of working like *Agile, Lean Startup, Scrum*, or organizational forms like *Holacracy*. As also spoken language and business language seem to mix inventions with innovations, the scope of innovation needs some further clarifications. According to OECD (2005):

"An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." (OECD, 2005)

OECD's definitions for innovation is commonly used, but lacks of definition what is "significant improvement". Hence, Francis (2014) defines innovation so that innovations and inventions are different in their impact because innovations deliver *sustainable* value:

"Innovation is *the full exploitation of the latent value of ideas (new to the unit of adoption) that strengthen an organization's competitive position and/or benefit other stakeholders."* (Francis, 2014)

Regarding sustainable value, Drucker (2002) noted that if innovation is the driving force of organizational success, it must be managed by acknowledging innovation as a systematic discipline. Hence, Drucker (2002) defines innovation as form of organizational activity, with the intended outcome that delivers wealth:

"Innovation is the specific instrument of entrepreneurship… the act that endows resources with a new capacity to create wealth." (Drucker, 2002)

According to Wiggins & Ruefli (2005), the objective of that process activity [whether entrepreneurial or intrapreneurial] aims to deliver sustainable competitive advantage on a continual basis. Regarding that, Schultz (2003) noted that innovation process works under a framework of conditions that make the emergence of innovation more likely. Thus, also innovation management would need to account elements that create environment where innovation is more likely. For example, ISO definition for *Innovation Management* (ISO 50501) has been defined as follows:

"Innovation Management is standardization of terminology tools and methods and interactions between relevant parties to enable innovation" (ISO 50501, Innovation Management, 2019)

Innovation literature further distinguishes innovation *generation* and *adoption*, which are seen equally important factor for competitive success (Damanpour & Gopalakrishnan, 1998). However, as the outcomes have neither reached common agreements, innovation forms (part 2.3.) and types (part 2.4.) that have often been used interchangeably need distinction.

2.3 Innovation forms

Industrial companies make their profit essentially through products. However, a universal misconception about innovation seems to be that the ideal goal of innovation activity is to create the next hot product (Doblin, 2019). This view naturally limits the scope of possible sources of competitive advantage that are not limited into tangible outcomes such as products, because on their own it produces least results: speed, quality, superior customer experience, revenues and costs are equally important factors within the ever-demanding

economy (Salesforce, 2019). Thus, the possible forms of innovation should cover also those that are more difficult to measure and less tangible, but which provide the sought benefits. Such enabling forms could be *new organizational structures, ways of working, new managerial paradigms* and *process*es that increase companies' performance (e.g. Hilmarsson et al. 2011; Damanpour & Aravind, 2002; Damanpour, 1991).

Adopting a broader scope for innovation is likely help in managing one's competitiveness by accounting multiple views to innovation by looking at what is valuable to customers: as perceived value is subjective, product innovation may not be enough to provide sustainable competitive advantage. Hence, whilst competitive advantage can come from various sources (e.g. size or assets), the pattern is increasingly coming to favor those organizations which can mobilize knowledge, technological skills and experience to create novelty in their offerings, and *the ways in which they create and deliver those offerings* (Tidd & Pavit, 2011). For example, recent technological advancements have enabled new value-creation opportunities to emerge beyond core products into new services and new business models.

Most companies stick to the former and focus their R&D spending on product innovation (Doblin, 2019). In their book, Keeley et al. (2013, p. 14) propose innovation to relate into four distinct categories that represent ten different "types" of innovation. Table one represents these distinct categories.

Table 1. *Innovation [forms]* (adopted from Keeley et al. 2013, p.14)

Innovation category		Innovation form
Finance	1	Business model
	2	Network and alliances
Process	3	Enabling proceses
	4	Core processes
Offerings	5	Product performance
	6	Product system
	7	Service
Delivery	8	Channel
	9	Brand
	10	Customer experience

However, as the terms "type" and "form" have been used interchangeably in many contexts, I argue that "type" represents the lower taxonomic category selected as a standard of reference for a higher category (Merriam Webster dictionary, 2019), and the term type and

form need further distinction. The next part tries to make distinction between the terms by providing understanding on the various types. Despite the linguistic mess, Keeley's et al. (2013) view suggests competitive advantage can arise beyond products. These categories include finance, process, offerings, and delivery. For example, finance category describes the logic how money is made (e.g. by products or by a digital platform) or how costs are shared (e.g. consortiums); process category describes how economic rent is created or enhanced (e.g. manufacturing process, design process, sales process); offerings describe how products, services or customer solutions can carry more customer value (e.g. enhanced performance, added-value); and delivery category describes the methods that enhance overall customer experience and ease of doing business with. It is very likely that within the digitally connected world each and every of the mentioned areas are interrelated and need equal attention. These categorizations are useful reference where innovation can potentially happen by describing the forms.

2.4 Innovation types

Besides the various *forms* that can be innovated, innovation literature has commonly identified four *types* of innovations that have different organizational impact. Table two represents the distinct innovation types.

According to Pisano (2015), the first type is routine innovation. This type of innovation adds incremental value into existing offerings and carriers a series of small improvements or upgrades made to a company's existing offering where the focus is on improving. This can target to, for example, enhanced performance, cost-cut, or differentiation (e.g. new features or cutting features). Such improvements are achievable with relatively small investments because routine development efforts built heavily on the current capabilities, and have close proximity the current technological path and knowledge (Pisano, 2015) Consequently, many large companies are very good at creating routine innovations because also their resources, business processes and culture are setup in a way to enable sustaining efforts (Nielsen, 2013). However, Christensen (2000, p. 202) argues that many established companies make the mistake of adding too many features to their products making their customers over-served with value attributions they necessarily do not need, and the products may become too complicated and expensive. Thus, routine innovation (as form of activity) could be argued being the cost of long-term success: incremental innovations (outcomes) usually produce the majority of the profits at short and mid-term, but which in essence

generate *predictable* cash flows to fund future development efforts that help to maintain long-term business continuity. (Pisano, 2015)

Table 2. *Innovation types (Pisano, 2015)*

	Leverages existing business model	Requires new business model
Requires fundamentally new competences	**3. Radical innovation** • Builds on existing competences • Fits with existing business model • Produces majority of profits • E.g. Nanotechnology	**2. Disruptive innovation** • Requires new business model, but not necessarily technological breakthrough • Challenges, or disrupts other companies' business models • E.g. platforms
Leverages existing competences	**1. Routine/incremental innovation** • Builds on existing competences • Fits with existing business model • Produces majority of profits	**4. Architectural innovation** • Combines technological and business model disruptions • E.g. Open source software, the block chain

The second type of innovation, disruptive, benefits also from the existing knowledge. However, unlike radical innovations, disruptive technology does not necessarily need any technological breakthroughs compared to the current technology: disruptive innovations create a new market or value network that eventually displace the current offering through evolution (Rahman et al. 2017). According to Christensen (2002, p. 58), there are two types of disruptive innovation: low-end disruption (i.e. new technology that costs less but performs worse for a while until it gets better but still costs less), and new-market disruption (i.e. a product whose main consumer is someone that was until then a non-consumer). An analogy lies in the history of disk drive industry. While the leading companies in disk drive industry were focusing on *recording capacity* of disk drives, smaller competitors were focusing on assumed customer-preference trajectory – small and lightweight compact disks (CDs). The initially low-performing disruptive technology (CD) surpassed the recording capacity of disk drives only after a few iterations. Hence, disruptive innovations are often inferior to existing market technology during their early life cycle stages, but which push rivals into an industry de-facto standard.

Given the anticipated accelerating pace of change (Brinker, 2016), determining whether an innovation is disruptive or not is critical because a disruptive innovation can radically unsettle the market status quo by overturning incumbents or creating new markets

stealthily (Guo et al. 2018). For example, history has shown that this type of innovation can overturn successful companies rapidly as it happened to Nokia or Kodak. Consequently, disruptive innovation require a completely new business model as it makes the previous generation product to serve only job-to-be-done functionality. (Pisano, 2015; Bower & Christensen, 1995)

The third innovation type, *radical innovation* requires fundamental changes in the technological trajectory and may require completely new competences (Tushman & Benner, 1997). This type of innovation is what we most commonly consider innovations, suggesting that radical innovations receive also most of the managerial attention. However, only 10 % of innovations are radical (Viima, 2018). Because radical innovations require departure from existing knowledge, for example, through research or learning, they are commonly depicted the most costly and difficult to attain. A very current challenge for established high-technology companies is to understand new and emerging technologies, which may eventually appear radical. Emerging technologies are close to radical innovation because they involve high uncertainties and ambiguity, but have radical novelty and prominent impact. (Rotolo & Rotolo, Ben, 2015) A great managerial challenge would be then to differentiate hype from what is real. However, if some emerging technology can solve existing problems more effectively or at significantly less cost (e.g. machine learning or the block chain technology), low ability to apply or adopt them can cause lower relative performance against competitors. A possible reference to be kept eye for is Gartner's Hype Cycle, which illustrates the cyclical phase between hype and real-world benefits of emerging technologies (Appendix A).

The fourth innovation type according to Pisano (2005) is *architectural innovation.* The Oxford dictionary for architectural innovation implies that "*architectural innovation creates an improvement in the ways in which components, at least some of which may not in themselves be innovative, are put together*". Consequently, architectural innovations combine technological and business model disruptions (Pisano, 2015). Afuah et al. (1995) further noted that innovation can happen across the whole value chain: innovation which is architectural for innovator, may turn out to be radical to customers, incremental to suppliers of components and equipment, and something else to suppliers of critical complementary innovations. (Afuah et al. 1995) Recent evidence from this is provided by platform economy where companies race for network effects rather than for profits generated by products at short or mid-term. A reasonable question for industrial organizations then becomes who will control future IoT platforms, and which eventually become the standard

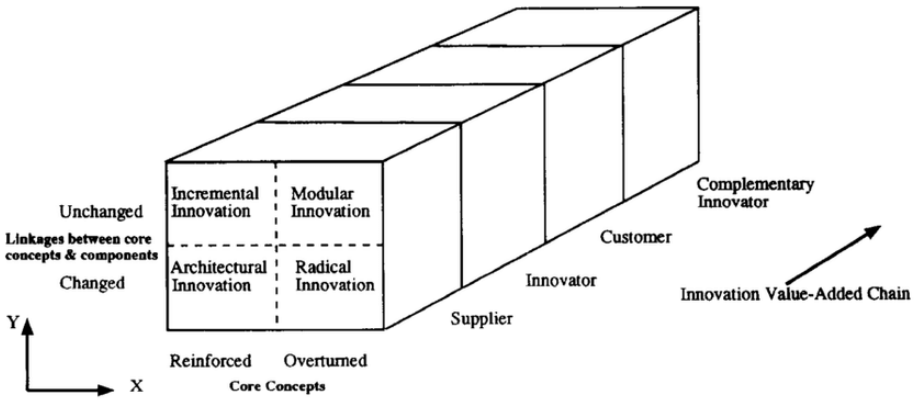


Figure 2. *Innovation Hypercube (Afuah et al. 1995)*

2.5 Technology S-curve and Innovation Management

The history has shown that products' and technologies lifecycle is not perpetual. As the Internet democratizes knowledge, companies' competitive advantage can rely on breakthrough innovations only on short or mid-term. Although the core products can be enhanced through incremental innovations or by providing complementary services for extending their lifecycle, competition in the industry, new entrants, substitute and complementary products will commoditize each technology faster due globalization. Thus, the ability to capture economic rents on long-term depends from the ability to influence on the external environment either by generating innovations or by adopting to change (Damanpour, 1991).

The generic Technology Lifecycle Model (TLC) views that each technology of a product is composed of four cyclical phases where each technology lives through different stages as it diffuses to the market. Once technologies evolve and advance, the ability capture economic rents varies as well.

- Research and development phase, where profit is negative due inability capture value.
- Ascent phase, where break-even is reached and the technology gains traction at the market. (A)
- The maturity phase, where gains are high and stable yet going into saturation. (M)
- The decline phase, where utility of the technology as well as willingness to pay starts to decline. (D)

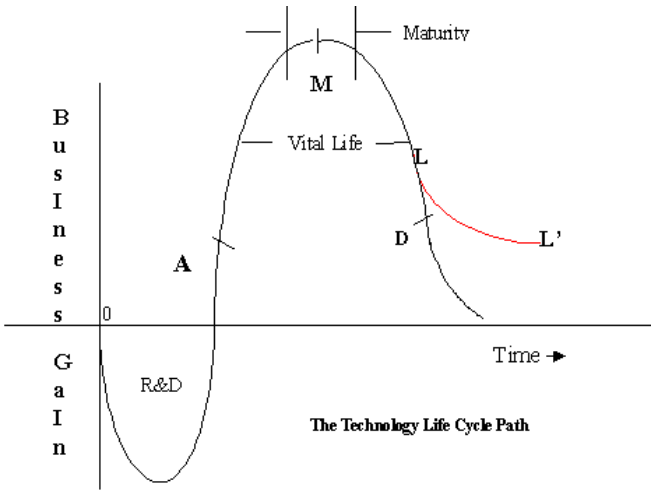


Figure 3. *The generic Technology Lifecycle (TLC) model phases*

The theory suggests that the rate of progress in performance during early stages of a new technology will be relatively slow. While the R&D costs may not be completely covered by the profits, the gains are usually negative. Once the technology becomes better controlled and diffused to the market, also the rate of technological improvement will start accelerating (see point A). As the performance eventually gets better through learning, it is likely that customers' willingness to pay increase and gains turn positive. The profit margins can be further enhanced through learning or process improvements. As the time goes by and the technology becomes better understood, the most obvious improvements (incremental) will approach their natural or physical limits so that increasingly more time or engineering effort are required to achieve marginally better performance (see point M). Figure 4 illustrates how the previous pattern of technological evolution forms an S-curve as old technologies become replaced by the new.

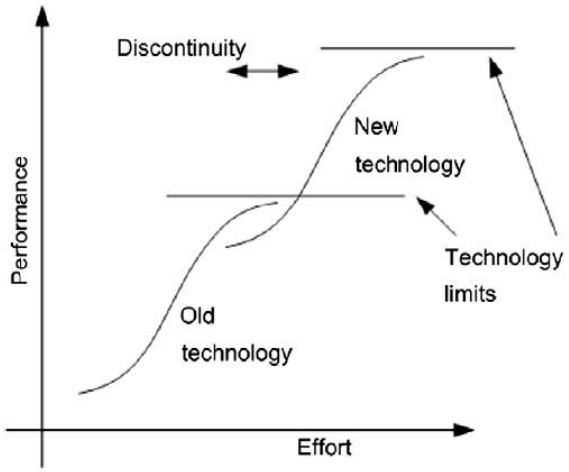


Figure 4. *Technology S-curve (Chapuis et al. 2013)*

The findings of increased global competition suggest that companies should become faster at either generating innovations or adopting them. As the required cycle time for new solutions is decreasing, high-technology companies that rely on sophisticated engineering staying ahead of international competition is getting harder every day (Christensen, 2001, p.12). Consequently, a great managerial challenge for successful companies is to manage the ability to switch technologies at the intersection point where the S-curve of old and new technology intersect (Christensen, 2001, p.48), and manage innovation in a disciplinary manner (Drucker, 2002). While maturity of a technology would imply low skills from market perspective and defined business processes, companies need to prepare themselves for the unknown by exploring and evaluating emerging technologies of the future. Thus, close attention and understanding how technologies evolve is key element for companies' general management. This can be governed, for example, through innovation strategy that aligns innovation with business strategy (Preetz et al. 2013). The discipline of innovation management then accounts different forms of innovation and different types of innovation to reach business goals. A possible time horizon for this activity is illustrated in figure 5 - McKinsey's Three Horizons of Growth. The model may serve as a useful reference where companies should aim at with their innovation approach by defining different planning horizons that support business viability and renewal.

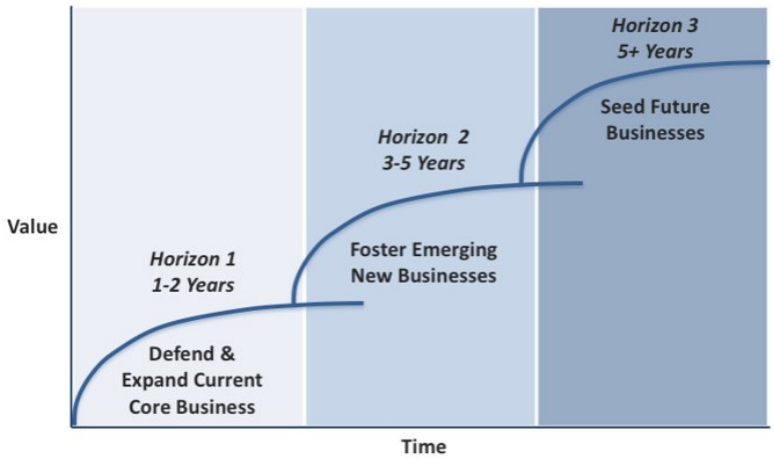


Figure 5. McKinsey's Three Horizons of Growth

This chapter introduced the theme the thesis discusses – innovation is matter of managing the things into right direction, and does not limit into product innovation. In next chapter, the theoretical background for the thesis is presented. The chapter proposes that innovation is enabled by the necessary organizational structures, but which need also

managerial capabilities to be effective. To overcome the challenges that many companies' have historically had poor ability to change, successful companies aim at increasing their innovation capability by examining their contingency-dependent innovation barriers that prevent organizations from engaging in innovation activity, or that distort change.

3. Theoretical background

Research seems not to have been able to provide silver bullets why some companies have managed becoming more innovative than the others have. Possible explanations have been sought at least from *resource perspective* (Barney, 1991), *leadership perspective* (Barney et al. 2018), *managerial capabilities* (Teece, 1997), and *cultural perspectives* (Zhang, 2018). The following chapter explains the four measured innovation-related concepts that the writer sees being important foundations for improving organizations capability to innovate and renew:

(1) **Dynamic capabilities**: the core of managerial activity for making organizations innovative through sensing, searching and seizing opportunities by transforming organizational capabilities.
(2) **Innovation capability**: organizational capability to innovate and renew enabled by the necessary organizational structures (as how an organization arranges its people, assets, tools, processes, culture) and dynamic capabilities.
(3) **Innovation culture**: traits in organizational culture that have been found to be beneficial for innovative performance.
(4) **Innovation barriers**: the potential factors that inhibit, block, or delay innovation by preventing organizations from engaging in innovation activity, or that hamper change.

3.1. Dynamic capabilities

Companies' ability to compete over time relies not only on their ability to increase resource efficiency but also on their ability to be simultaneously innovative (Tushman, 2003). To address such demands, Teece & Shuen (1997) proposed that companies need both *ordinary capabilities* and *dynamic capabilities.* While the ordinary capabilities enable the production and sale of a defined set of products and services with certain degree of proficiency, dynamic capabilities represent the necessary capabilities and abilities to change as response to the

environment (Teece et al. 2016; Teece & Shuen, 1997). This term is close to *organizational agility,* which has been used in similar manner (Baskarada & Koronious, 2018). However, Teece et al. (2016) argue that dynamic capabilities relate to organizational *agility* so that strong dynamic capabilities foster *organizational agility*, and represents the ability to adapt into changed market conditions. Hence, practitioners and researchers natural interest would be in identifying factors that affect dynamic capabilities and organizational agility positively.

Hueske et al. (2015) found in their literature review that three distinct dynamic capabilities support innovation. Alike to Teece's et al. (2016) findings, on one hand innovative organizations are able to adapt if the environment is changing. This represents the *adaptive capacity* that helps organizations to align themselves to environmental change (Wang & Ahmed, 2007). Such change could be shifts in competitive landscape, technological disruption, emerging technologies, or megatrends.

Innovative organizations are also able incorporate new information, learn, and develop new competences to cope with uncertainties of the innovation economy. Consequently, successful organizations invest in learning and continuously develop new competences. (Wang & Ahmed, 2007) *Absorptive capacity* helps organizations to prepare themselves for future by incorporating new information. The challenge for established companies is to keep their learning pace sufficiently high or else it may turn out difficult, if impossible to start utilizing external knowledge in a timely manner. For example, emerging technologies would need to be understood beyond corporate research functions by those why have deep domain expertise in certain business processes such as in manufacturing, logistics and sales.

The third capacity, *innovative* capacity represents the ability to put theory and knowledge into practice and execute what adaptive capacity and absorptive capacity produce. Wang & Ahmed (2007) argue that innovative capacity is the ability to align organizational constructs to drive innovative behavior through organizations. To support this goal, research has found that organizational culture and disciplined approach to innovation along with tools are beneficial to innovation (Wang & Ahmed, 2007). Below, the three dynamic capability constructs of Wang & Ahmed (2007).

- ***Adaptive capacity*** *defined as the capacity of a system to adapt if the environment is changing. Adaptive capability captures how an organization aligns itself to environmental change.* (Wang & Ahmed, 2007)

- ***Absorptive capacity*** *defined as the ability to incorporate new information. Successful organizations invest in learning and continuously develop new competences.* (Wang & Ahmed, 2007)

- ***Innovative capacity*** *defined as the ability to develop new products and/or markets through aligning strategic innovative orientation with innovative behaviors and processes through incorporation and exploitation of the value of new information and ideas. This involves organizational culture, processes and tools, basic skills or even a shared language.* (Wang & Ahmed, 2007)

According to Laaksonen & Peltoniemi (2018), the purpose of dynamic capabilities research is to explain sources of competitive advantage. The ordinary capabilities (also called operational or 'zero order' capabilities) determine how a company makes its current living whereas dynamic capabilities enable the company to change (Laaksonen & Peltoniemi, 2018; Winter2003; Zollo & Winter 2002). However, the concept of dynamic capabilities is rather conceptual, and lacks of practical perspective. To provide concreteness, Teece & Shuen (1997) saw that managers are in key role in building dynamic capabilities through their decisions by integrating, building and configuring various internal and external competencies to address rapidly changing environments. According to Teece (2018), the concept of dynamic capabilities essentially says that what matters for business is corporate agility: the capacity to (1) sense and shape opportunities and threats, (2) seize opportunities, and (3) maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets (Teece, 2018). Figure 4 represents the activities for each dynamic capability defined by Teece (2018).

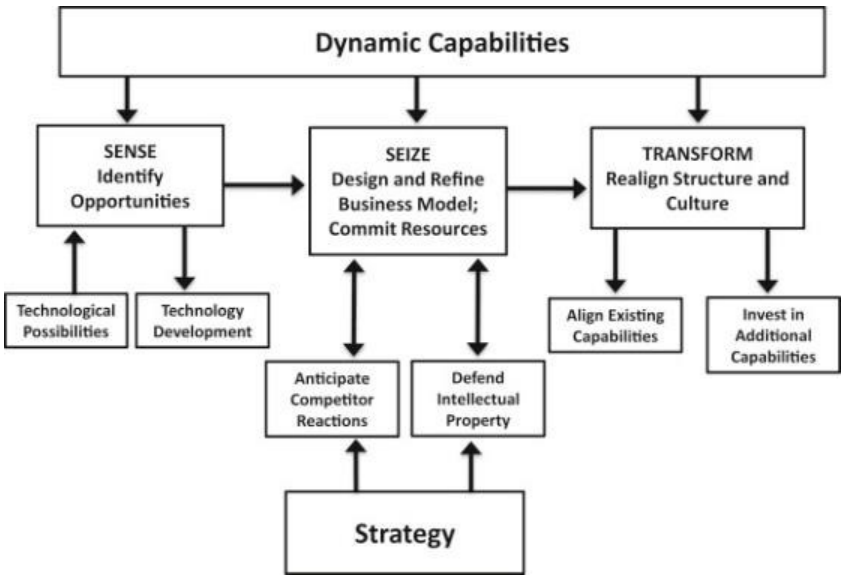


Figure 6. *Dynamic capabilities (Teece, 2018)*

From managerial viewpoint, dynamic capabilities would solely be built through managerial capabilities and behavior. This view under-emphasizes the input of employees that may possess drastically deeper domain expertise in some specific fields or industries. Recent literature has tried to find complementary views that contribute to dynamic capabilities. For example, Sprafke (2014) proposed that *empowerment* facilitates the deployment of individual capabilities, which enhance the influence of dynamic capabilities. Supportive evidence to this has been found from Wolgemuth et al. (2019), who identified a positive relationship between employee participation to dynamic capabilities. Based on that evidence, it would be seemingly important to find right balance between control and freedom because employee participation and informal control affect positively on dynamic capabilities (Wolgemuth et al. 2019). Arguably, these findings are not limited only to generating innovations, but also to innovation adoption by identifying the high-payoff opportunities.

3.2. Innovation capability

Besides dynamic capabilities, innovation literature has suggested the concept of innovation capability for describing necessary elements that potentially make a company innovative. Arguably then, a link between dynamic capabilities and innovation capability exists. The proposed link, however, has remained somewhat unclear in literature. For example,

Brezhnik & Hirschnich. (2014) found altogether six distinct prevailing views regarding their relationship:

(1) Innovation capability *is* a dynamic capability itself
(2) Dynamic capability is the *outcome* of innovation capabilities
(3) Innovation capability is a *component* of dynamic capability
(4) Dynamic capabilities are *precondition* for innovation capability
(5) Innovation capability *operates on* dynamic capabilities
(6) Innovation capability is synonym for a dynamic capability

According to Breznik & Lahonovik (2012), innovation capability does play a dominant role in sustaining a competitive position. However, given the ambiguity of various views, and as the researchers noted that "*the notion of innovation capability is much older than the notion of dynamic capability"* – it would make no sense to deal with the same construct just by different name. Thus, I accept the notions (4) and (5) because such definitions enable a way to examine innovation capability conceptually from two distinct perspectives as it separates the underlying *managerial factors* and *organizational structures* that form the organizational capability to innovate.

Unsurprisingly, researchers have also been using also the term *innovation capability* in an inconsistent manner over time. For instance, in line with dynamic capabilities (part 3.1) Lawson & Samson (2001) propose that innovation capability is a higher-order integration capability, that is, the ability to mold and manage multiple organizational capabilities in search of innovations (Lawson and Samson, 2001). Further, Wang and Ahmed (2004) defined innovation capability as "*an organization's overall innovative capacity of introducing new products to the market, or opening new markets, through combining strategic orientation with innovative behavior and process*". Arguably, neither of these definitions imply how the innovative behavior, processes or strategic orientation is attainable. Thus, perhaps in a more comprehensive manner, Francis (2014) defined innovation capability as an organizational property "…*that underpins an ample flow of multiple, value-creating and novel initiatives*" (Francis, 2014). His view highlighted that innovative organizations represent certain organizational characteristics, such as strong leadership and decision-making capabilities, innovative competencies, support processes, and encouraging culture – that element enable innovative and creative ideas to be implemented (ibid). This view not only fit into the proposed three dynamic capabilities of

Wang & Ahmed (2007), but also to the view of Teece's et al. (2016) organizational agility and Brezhnik & Hirschnich's (2014) notion (4) and (5).

Similar to Francis' (2014) findings of certain organizational properties, Loewe and Dominquini (2006) concluded that organizations' innovation effectiveness is built upon *leadership, organizational culture and values, people and skills, and processes and tools*. In such effective context, an organization is well-aligned around a common definition for innovation, the organizational culture supports challenging the status quo, and systematic and structured approach to innovation enables aligning organizational structures, processes, tools, culture and leadership around innovation (Loewe & Dominquini, 2006). Figure seven represents the constructs of innovation capability as proposed by Loewe & Dominquini (2006).

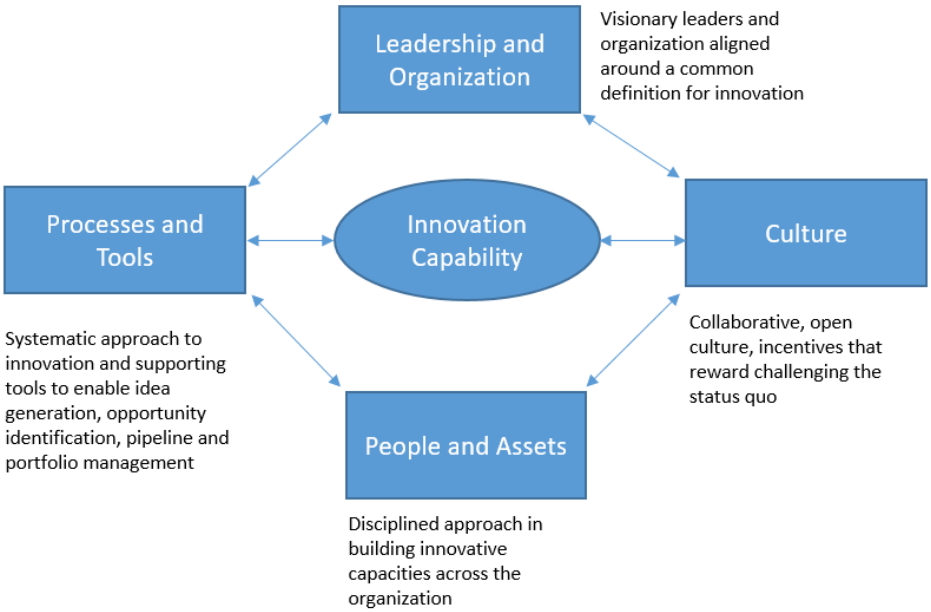


Figure 7. *Innovation capability (Loewe and Dominquini, 2006)*

The proposed views in this part helps to understand the constructs of innovation capability, and reduce the descriptive nature of the concepts. I conclude that innovation capability operates on certain managerial capabilities (dynamic capabilities) but which need the necessary organizational structures, namely *leadership, culture, people and assets, processes and tools* as described by Loewe & Dominquini (2006) to be effective. The distinction between the innovation capability and dynamic capability is important to be made because in essence they represent different abstraction levels: managers and employees work

under certain organizational constraints, but which managers can influence by displaying what is expected from them - strong dynamic capabilities.

3.3. Innovation culture

Research has produced dozens of studies that have aimed to investigate the relationship between innovativeness and company performance. As the results imply that there exists significant positive relationship between the two (e.g. Hilmarsson, 2011; Zhang et al. 2018), increasingly many organizational researchers have become interested in innovation from cultural perspective. However, research has been unable to answer what is the underlying mechanism through which innovation culture contributes to higher innovative performance (Zhang et al. 2018).

Driven from Schein's general definition of culture (1985) as the "*pattern of shared basic assumptions as groups solve its problems"*, culture can be applied into the context of innovation as well. Hence, researchers have become interested in examining cultural traits that contribute to higher innovative performance of organizations. According to Ireland et al. (2006), innovative culture is the *"orientation toward experimenting with new alternatives or approaches by exploring new resources, breaking through existing norms, and creating new products to improve its performance.*" Therefore, in such innovative culture, organizational members are collectively supported generating or adopting innovations by bringing up new ideas and challenging the status-quo.

Capon (1992) views that the key aspects of innovation culture can be described as *creativity, openness* and *receptiveness to new ideas, risk taking, and entrepreneurial mindset* (Capon et al. 1992). Arguably, such organizational characteristics increase the likelihood of innovative success by maximizing the number of innovative attempts, as well as individual effort (Amabile, 2011). In fact, Schultz (2003) noted that innovation process works under a framework of conditions that make the emergence of innovation more likely where one of the elements is culture.

Thorsten et al. (2013) argue that while creativity is a construct of innovation, the enablers of the initiatives arise from the culture. Alike, Salge and Vera (2012) view that organizational culture has a complementary role in enabling organizations to translate innovation activity into tangible performance benefit. However, Tushman & O'Reilly (1997) are stricter and argue that organizational culture lies at the heart of innovation. Hence, managerial awareness of such phenomenon is important because motivation drives people's

individual and collective efforts (Hueske et al. 2014; Klein & Kozlowski, 2000), and that culture could be viewed as a way to drive human capital for certain behavior.

4. Innovation Barriers

Lack of innovation has been confirmed not due lack of innovative ideas (Pinchot, 1985). The finding suggests that many organizations have not been benefiting from their full innovative potential because the vast majority of companies have had poor ability to change in light of history (part 2.1). Innovation barrier research is one possible approach to investigate the perceived gap between what the leaders want and what their organizations deliver. Studying large and established organizations is a fruitful environment studying these factors because they have established structures, practices, and policies that provide predictability and order, but which yet can conflict with innovation that is inherent to change. Thus, besides understanding enabling factors, equally important would be to understand factors that hamper innovation through organizations members' experiences and perceptions.

4.1. Barrier types

Mirow et al. (2011) defined innovation barriers as "*any factor that inhibit, block or delay innovation"* (Hueske et al. 2014; Mirow et al. 2011). To provide granularity, I feel necessary to divide these factors into two distinct barrier types that describe their ultimate source. For this purpose, D'este et al. (2012) separated factors that prevent organizations from engaging in innovation activity, and factors that distort the process itself. I argue that this division helps to understand better the nature of barriers, and to distinguish the elements that influence on either of the factors conceptually. For example, while the former would imply lack of mental alignment of the organization (or certain parts of the organization), the latter would explain factors arising from the focused and purposeful process or discipline. For example, Hall and Martin (2000) proposed that various technological, commercial and social uncertainties need to be overcome before committing to any innovative project, D'este et al. (2014) found that various cost factors, knowledge factors, and market factors might hamper innovative goals by preventing go-decisions, and Heskett (2007) found that various cultural, structural, process, and competency barriers potentially hamper the process activity.

4.2. Barrier categories (EOGI barrier model)

To understand better the possible sources of innovation barriers, a literature review based on EOGI barrier model proposed by Hueske et al. (2014) is followed: the potential barriers can

arise from *external* (e.g. investors, customers, legislation), *organizational* (strategy, leadership, structure, size, resources, organizational structures & processes, organizational culture, and organizational learning), and *individual* level factors (abilities, attitudes). The review in this study is limited to organizational factors.

Figure eight represents the followed EOGI barrier model (Hueske et al. 2014). The model is a useful reference for looking at the potential sources of innovation barriers. For example, various internal factors that are due organizational contingencies and individual level factors can prevent organizations from engaging in innovation activity, or limit such process through abilities or attitudes. This is in-line with the conclusions of D'este (2012). The model is complemented by adding leadership as separate category that can be doubt viewed both as an enabling element, but also such that can cause severe distortions if not aligned with innovation goals.

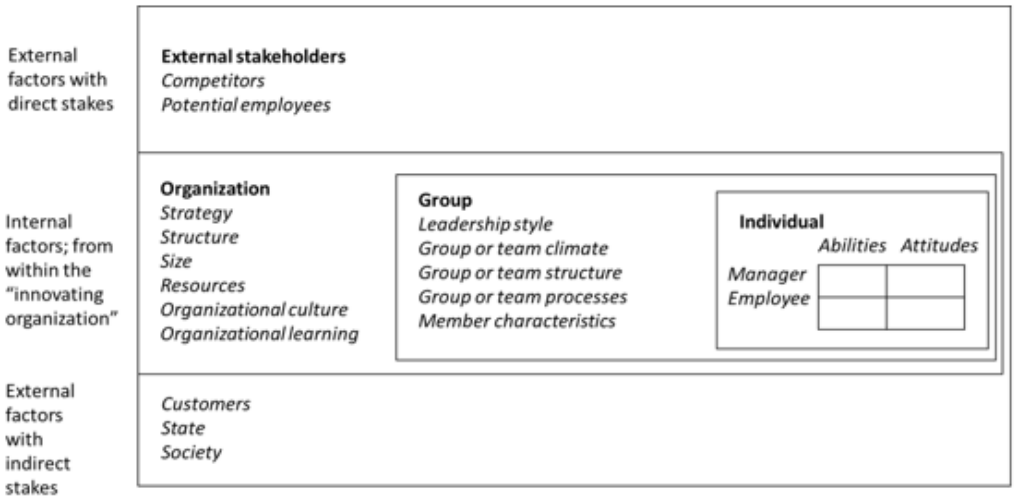


Figure 8. *EOGI barrier model to innovation (Hueske et al. 2014)*

4.2.1. Leadership barriers

Leadership and management skills are essential for organizational success. This includes setting the vision, mission, and goals for organizations. This requires envisioning the foreseeing future and establishing direction through strategic thinking and displaying appropriate leadership for aligning organizations with overall business strategy. However, lack of such managerial constructs (e.g. strategy, mission, vision) or leadership skills (e.g. inspiration and aspiration) may hamper achieving innovation goals through lack of direction, lack of commitment, motivation or effort. Otherwise, certain leadership and management styles have been found to suppress creativity, which is an essential element of innovation.

4.2.1.1. Strategy

In their literature review, Hueske et al. (2014) list most commonly cited innovation barriers related to strategy: unclear or no strategy, as well as other priorities and goals. Thus, lack of innovation strategy could imply lack of priority in innovation (Ren, 2009). According to Cooper & Edgett (2010), lack of innovation strategy may result in lack of direction and result drifting from one ad hoc decision to the next. On the other hand, innovation strategy is found to help to prioritize different projects (Cooper & Edgett, 2010). Clearly, if there is no innovation strategy, then every other priority and goal compete with innovation on the scarce resources (ibid). However, it is notable that many companies lack a clearly articulated and well-communicated product innovation and technology strategy (ibid). Furthermore, if the overall business strategy is unclear, or the organization lacks innovation strategy, organizational capabilities can become underused and lead to lack of strategic fit (Cooper & Edgett, 2015). Low alignment would then mean poor degree to which an organization is matching its resources and capabilities to the opportunities in the current environment (Cooper & Edgett, 2015). Arguably, poor fit would possibly lead into low innovative capacity (part 3.2).

***Table 3**. Innovation strategy and technology strategy differences (Preetz et al. 2013)*

	Innovation Strategy	**Technology Strategy**
Sought Form	*Organizational* *Product* *Process* *Service*	*Specific technology* *Specific product*
Sought Type	*Technology* *Incremental* *Radical* *Sustaining* *Disruptive*	*Incremental or disruptive*
Alignment	*Business goals* *Capabilities* *Culture* *Other strategies* *Structures* *Processes* *Values*	*Business goals* *Capabilities* *Other strategies* *Values*
Function	*Deliver the most appropriate innovations to achieve business goals, including technology strategy*	*Achieve overall strategy through a specific technology/technology trajectory. Guides the direction of technology, builds necessary knowledge around it*

Inconsistent terminology often causes unnecessary troubles for companies. For example, strategy and innovation strategy have often been used interchangeably although

they mean different things (Preetz et al. 2013). Preetz et al. (2013) noted that given Mintzbeg's well-known idea that organizational structures follow strategy "like the left foot right", drawing a differentiation between business strategy and innovation strategy would be important to align organizations properly with their goals. The researchers claim that while a technology strategy prepares a company to focus on a specific technology for a specific end purpose, an innovation strategy prepares companies to deliver *the most appropriate innovations to achieve its business goals*. Furthermore, the researchers claim that innovation strategy describes as well the underlying structures, processes and practices that are needed to maximize the possibility of achieving the overall business goals. Such enablers can be *innovation department, innovation management reporting lines, idea management systems, innovation processes and innovation reports*. (Preetz et al. 2013). Lack of these constructs could be seen potential barriers – but increasingly many organizations have been appointing new roles, such as chief innovation officer (CIO or CINO) beside chief technology officer (CTO) as person primarily responsible for change management and innovation. Table three reports the differences between innovation strategy and technology strategy that Preetz et al. (2013) noted.

4.2.2.2. Leadership

Management and leadership may include various paradoxes. According to Hunter & Cushenberry (2011), innovation leaders are required to strike a balance between two conflicting roles, such as encouraging new ideas, but limiting to those that are most viable. Furthermore, the role includes balancing between other situational and contextual factors and conflicting roles. When innovation is close something that is changing, some researchers call for transformational leadership style where leaders work to identify needed change and create the required vision to guide the organization through inspiration (Antonakis & House, 2013). Otherwise, innovation literature commonly identifies certain leadership styles and traits that are seen to lead into higher innovative success or better innovative outcomes. Within innovation literature, such leadership style for innovation is often depicted as *visionary* leadership (Hilmarsson et al. 2011). However, research has found that organizations need also enacted support beside articulated to be successful, but many organizations face difficulties to get top management or higher hierarchies to support that cause lower innovative success (Hueske et al. 2015; Polley, 1989). Policy statements can enact as innovation barriers (Anderson & West, 1998) and lack of priority to improve retain status quo (Hueske et al. 2015; Christensen, 1997, p. 58).

4.2.2. Organizational barriers

According to Hueske et al. (2014), barriers at the organizational level include any factor that are due organizational contingencies. This include structure, size, resources, organizational culture and organizational learning. The researchers argue that these elements are the necessary *managerial levers* that are in control of companies.

4.2.2.1. Structure

Research on organizational structures around innovation has been intense, and the results tend to be conflicting. While some studies call for entrepreneurial management teams and robust organizational designs (Teece, 2016), others claim that hierarchical companies, even with poor managers, have higher probability for better innovative performance (Will, Kfairy, Mellor, 2017). Hence, rather than looking at certain organizational structures that are optimal for innovation in the context of large and established industrial organizations, looking at the implications of large size and structure is more suitable perspective for this study.

Literature finds evidence that organizations have the tendency to use of structures that discourage innovation through age, size, and success (Van de Ven, 1986). For example, Hueske et al. (2015) noted that loss of innovation gatekeeper might enact as a major innovation barrier. The findings are consistent with other studies that centralization (the extent which decisions are made by higher echelons) and formalization (the extent to which formal rules and procedures are used in the organization) negatively effect on innovation (Damanpour, 2012). That kind of structure mainly pursue for efficiency and consistency by adopting the structures and procedures through institutionalization and legitimacy (Hueske et al. 2015; Damanpour 2012; Riebero & Scapens, 2006, p. 96).

4.2.2.2. Size

Empirical findings concerning the size of an organization to innovation is equally ambiguous (Hueske et al. 2015; Damanpour, 1992; Storey 2002, p.161). Some studies claim that organizational size is proportional to innovation, and other represent even curvilinear relationship between company size and innovativeness. However, the case for many established organizations is that they often possess great amount of available funds to explore new opportunities and to do research, especially when compared to smaller ones. The possible explanations for Van den Ven's (1986) findings of the negative effect of size to innovative performance can be various. For instance, many established companies are

driven by organizational routines and various organizational forces drive innovation towards company strengths rather than looking for new ideas and opportunities (Dougherty, 1992; Kanter, 1982).

According to Dougherty (1992), a key issue in routines is that they cause difficulties in linking technological and market possibilities. He argues that two distinct phenomena may affect the possible solution space: (1) departmental thought worlds and (2) organizational routines. In departmental thought worlds, various functions and disciplines view future direction and uncertainties from different perspectives. For instance, the technical people, field people, manufacturing people, and planning people may not share the same view of organizational tasks. A possible innovation barrier hence could be that the organizational members do not understand other roles beyond their own function and have little interaction with each other. Dougherty (1992) classifies the routines into *interdepartmental relations, market definition,* and *product standards* (Dougherty, 1992). The first routine governs the 'thought world' relations by prescribing narrow roles and limited relationships. The second routine impose a predetermined definition of technology-market issues. Organizational routines can possibly reinforce the effect because routines encourage thought world separation. (Dougherty, 1992) The third routine imposes standards that may not fit for new products. For instance, developers are forced to redefine new ideas into an established business, which reduce and inhibits organizational learning (Dougherty, 1992). However, recently innovation has been considered beyond the sole responsibility of the R&D department, new product development, or the marketing team (Hilmarsson et al. 2011).

4.2.2.3. Resources

Mueller et al. (2013) concluded the quite evident that resources are vital to innovation. For instance, resource availability, resource allocation choices, and the intensity of use of resources influence on the success of innovative efforts (Hueske et al. 2015; Mueller, 2013). However, lack of resources (e.g. financial and personnel) for innovation have been frequently identified as loss of innovation in large companies (Ren, 2009). Ren (2009) argues that the lack of resources is due the simple reason that resources are not made available for innovation. Again, this finding would remind the importance of creating innovation strategy that would guide organizations towards how innovation goals are

achieved by separately defining the related strategic innovation activities and budgeting them accordingly.

Shortage of staff and time is a general barrier to innovation (Ren, 2009). However, also lack of development personnel or qualified personnel may enact as a barrier (Hueske et al. 2014; Hadjimanoulis, 1999). For instance, lack of development personnel resources for improving any kind of existing process is a major barrier. Ren (2009) found also that lack of prioritization to improve existing processes acts as a process innovation barrier. This finding is in line with Tallman (2005) that engineers are often occupied with putting out fires (troubleshooting) rather than engaging in developmental activities. On the other hand, literature suggests that organizational slack and freedom foster creativity at the individual level (Hueske et al. 2014). However, organizational slack has been found to have positive effect on technical innovation, and that the effect is lesser on administrative innovation (Hueske et al. 2014).

Holmström (1989) investigated the agency costs and innovation and found that mixing hard to measure activities with measurable routine activities is particularly costly. He argued that it will lead to misallocation of attention either across uncertainty or across tasks. Therefore, his findings advocate that innovative efforts should be granted with appropriate incentives. However, with starved resources a reality for many large organizations or functional managers is that they are reluctant to allocate funding and staff to projects they perceive risky (Kaplan & Winby, 2007).

4.2.2.4. Organizational culture

Organizational culture affects the people and groups interacting with each other by defining their social norms. Hence, organizational culture should be learning-oriented and encourage failing without personal consequences (Loewe & Dominquini, 2006). Otherwise, conflicting organizational culture, lack of support from higher hierarchies have been found to hamper innovation significantly (Hueske et al. 2015). Baer & Frese (2003) noted that effective innovation process could only be achieved if strong climates for *participative* and *psychological* safety exist in the company. Furthermore, according Kahn (1990) workers were more engaged in situations that offered them more psychological meaningfulness and psychological safety, especially when the managers were more psychologically available. Hauschildt (2003) argues that the success of innovation is greatly dependent on the abilities of individuals who enthusiastically support the new ideas. Alike, Richards (1991) emphasize

the importance of individual creativity (Hueske et al. 2014). With this regard, innovation barriers cover also factors that prevent individual or group creativity to take place (ibid).

4.2.2.5. Organizational learning

Modern economies are commonly characterized learning economies or knowledge economies (Simandan, 2010). Organizational learning (OL) is then the outcome or process of improving organizational actions through better knowledge (Hueske et al. 2014; Edmondson, 2002). Chadwick and Raver (2010) concluded that facilitating OL is necessary for organizations to remain adaptive and competitive in today's ever-changing business environment because knowledge is the crucial resource of organization and learning is the most important process of organizations (Hueske et al. 2014; Johnson, 1994). Consequently, also the ability to learn from failure is one of the keys to innovative success because it also helps minimizing factors that disrupt the innovation process or that hamper innovative outcomes (Hueske et al. 2014; Hall & Martin 2005, p.274).

OL relates to individuals regarding that individuals are those who perform the learning. Some studies (e.g. Laursen, 2012) have shown that employees are more likely to develop innovations when they are exposed to a variety of diverse sources of external knowledge (Hueske et al. 2014). However, for many managers higher level learning is typically conceptualized as involving a tension between the use of existing knowledge (exploitation) and developing new (exploration) (March, 1991). This implies an essential complementarity between internal and external sources of knowledge in large organizations, and that innovation is a learning activity that can be facilitated via networks.

4.2.2.6. Processes

Most studies that examine innovative performance of organizations tend look at organizational variables' (e.g. strategy, structure, people, and culture) effect on performance, and regard that R&D performance is the function of organizational parameters (e.g. creativity, problem solving, competence, and investments). However, successful R&D groups do not only generate innovative ideas but aim also transfer the newly created concepts through the organizational system for economic gain. Consequently, it is important to understand how the current organizational processes support or inhibit the flow of ideas. (Thamhain, 2003) Much of the past literature has also emphasized the ideation process (i.e. how to produce ideas) while execution of ideas has become the key source of competitive advantage (Wiggins and Ruefli, 2005). For example, Cheng & Groysberg (2018) asked

directors across the globe about the effectiveness of their board's processes for supporting innovation and found that mere 42% rated their processes as above average or excellent. In contrast, board members rated them better on risk management than on innovation. Clearly, these findings necessitate that companies have had difficulties in systematizing their innovation activities: if no formal innovation process or strategic plans exist, the same opportunities as the most obvious (e.g. routine developmental tasks) are not given the same opportunity to be implemented. However, it has been found that hierarchical authority can be especially detrimental during the idea generation phase of the innovation process, whereas hierarchy can be beneficial during the idea selection phase by reducing a bias toward promoting the selection of one's own ideas (Keum & Dongidl, 2017). To overcome challenges, Lundvall (2016) suggest that innovation should be seen more as an interactive process of learning rather than process of information exchange.

4.2.3. Individual level barriers

4.2.3.1. Attitudes

Organizations are driven by individual behavior. Thus, realizing a continuous flow of innovations requires employees to be both willing and able to innovate (Jong & Hartog, 2007). Being able and being willing to draws on the micro-level perspective where innovation depends on the abilities and attitudes of the very individuals (Hueske et al. 2014; Anderson et al. 2004; Klein and Kozlowski, 2000a). At the individual level, the abilities are defined as the talent means to accomplish something, and attitude as a settled way of thinking or feeling about. The necessity to divide abilities and attitudes into different hierarchical layers (employees, managers and leaders) is needed because different hierarchies represent different intentions in their outcomes. While employees seek to produce predictability and order, leaders aim to produce change. (Kotter, 1990) However, failure often occurs even if managers are aware of the need for change (Hueske; 2014; Johnson, 1988). Hence, the paradox is likely to become more understandable through analyzing these variables (abilities and attitudes) from two layers (managers, employees).

Attitude of a person is commonly determined by experiences and psychological factors like values, beliefs, and perceptions. Studies related to managers' attitudes refer mainly to individual attributes, such as lack of commitment, unwillingness, and change resistance (Hueske et al., 2015). From employees' part, the most commonly referred innovation barriers relate to employees' attitudes such as preferring old ways, hesitation, unwillingness,

fear of changing the way of doing things, efforts are considered useless, and that status quo is good enough (ibid).

Sandberg and Aarikka-Stenroos (2018) found that restrictive mindset is a barrier to innovation. They found that collective mindset can be a major impediment to innovation (ibid). Kanter (1982) found that establishing a change is difficult to achieve because "change is at the odds of administrative process of the past. She refers to "segmentalism" - an approach to organizing and managing that discourages change, even in the face of obvious problems. Price and Choi (2000) found that congruence between personal values and innovation values is strongly related to employees' commitment. Further, Henderson (1993, p. 248) argues that incumbents' efforts with respect to radically new technologies are characterized by "incompetence" and "underinvestment. (Tellis & Chandler, 2000, p. 68).

4.2.3.2. Abilities

The constraint of innovation seems not to be lack of innovative ideas, but instead, facilitating processes, abilities and attitudes that result in implementation of successful innovations (Pinchot, 1985). Thus, it is important to understand how the talent means and abilities of individuals affect innovative performance of the whole organization.

Van den Ven (1986) suggested basic managerial problems relate to individual capabilities, as well as processes and structures. Woodman et al. (1993) found cognitive factors, including the abilities and skills involved in idea production, the ability to scrutinize the critical factors of a situation without being distracted, and the ability to produce limitless ideas combined with the ability to work through the problem-solving process and implement a solution. Thus, also lack of skillful brainstorming sessions could enact as an innovation barrier.

Hueske et al. (2015) found that fewer part of the past literature is naming managers' abilities such as professional expertise, management or leadership skills as an innovation barrier. However, this would be an important future research area as technologies evolve at increasingly faster pace. Dynamic capabilities through managers' understanding of the possibilities of new and innovative technologies may be a good perspective because the required capabilities may have transformed dramatically through the introduction of new digital technologies – and the ability to enact can be one key component in determining how new ideas are translated into value. For example, in PA's report, only 24 % of surveyed

executives were fully confident they have defined the skills and activities they need to be innovative.

5. Research design and methodology

The research was done by surveying one business line of a large and established industrial organization regarding its members' perceptions about potential innovation barriers, innovation culture, and innovation capability. The views were measured across two groups: managers with staff responsibilities, and employees. The separation was considered necessary to reflect differences between groups and to identify possible root causes of barriers. Factor analysis was used to fit a theory-grounded structural model into the data. The structural effects were then analyzed for each group by using regression and by comparing the structural coefficiencies and statistical significances across the groups. Further investigation lines for qualitative research were drawn based on the results.

5.1. Theoretical model

Figure nine represents the theoretical model of the study. The model proposes that innovation barriers have direct and negative effect on innovation capability, and that innovation culture *moderates* that effect. The proposed model further views that innovation barriers are *mediated* by dynamic capabilities. Thus, the level of dynamic capabilities would explain why there is a certain strength of relationship between innovation barriers and innovation capability. Whereas strong dynamic capabilities would decrease the negative relationship between innovation barriers and innovation capability, poor dynamic capabilities would reflect into more strongly perceived barriers. Analyzing innovation capability through the theoretical model may help to explain the underlying mechanisms how innovation capability can potentially be enhanced. Part 5.2.2 explains the chosen variables under each category.

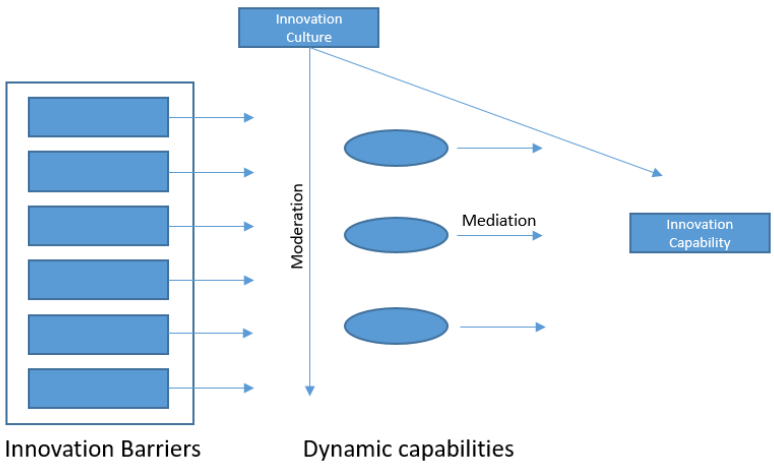


Figure 9. *Theoretical model of the study*

5.2. Methodology

Innovation scholars face an enduring research problem: how to make models that are testable, yet reflect the complexity of real business environments (Damanpour & Gopalakrishnan, 1998). The chosen methodology for the study aimed to address this by backing up on theory (part 3) and by proposing a model that has not been priori tested by doing exploratory research. The data was gathered surveying one multinational large and established industrial organization regarding the perceptions about *innovation barriers, innovation culture, and innovation capability*. The respondents were asked to rate innovation-related concepts that could not be measured with single questionnaire items. Likert scale was used in measuring the perceived severity or goodness of each concept. Structural Equation Modeling (SEM) was then used in analyzing structural relationships of the concepts quantitatively. The validity and reliability of the model were evaluated against the most commonly used fit criteria in field.

5.2.1. Structural Equation Modeling (SEM)

During the last decade, SEM has gained increasing popularity among researchers and practitioners due the recent advancements of user-friendly analytics software. The method has helped also non-academic researchers to perform relatively complex analyses of causal relationships, and to test moderation and mediation effects. According to Dmitrov (2006), the method is considered as an appropriate method with a *latent variable system* in which various constructs (latent variables) have causal influence on the observed variables. (Dmitrov, 2006) A Structural Equation Model (SEM) was fit into the data regarding the proposed theoretical model (part 5.1). This was done first by conducting Exploratory Factor Analysis (EFA) where the aim was to identify underlying response patterns through common variance. Then these patterns were reflected against the underlying theory, and modifications were made on the structural model by using judgmental criteria (part 5.1). Modifications to the factor structure are presented in appendix B, of which model fit was tested in Confirmatory Factor Analysis. Once adequate model fit, construct validity and reliability were achieved, regression analyses were performed to identify the effects of structural relationships and moderation effects. Research process (part 5.3.) explains this further.

5.2.2. Survey

The survey was sent to global scale, including all the geographical business areas of the case organization. The survey included background information, such as experience within and outside the company, and job-position as a hierarchical role (employee vs. manager with staff responsibilities), Information on the hierarchical role was used in the analysis to classify respondents. The respondents were asked to rate on a Likert-scale (1-5) their subjective view if the proposed barriers were significant or not. The respective scale was 1 (Strongly disagree), 2 (Disagree), 3 (Neither Agree nor Disagree), 4 (Agree), 5 (Strongly Agree). I don't know option (0) was included, so that possible reliability issues from the data could be overcome. Similar numerical scale was presented regarding innovation culture and innovation capability. For these variables, the response scale evaluated the performance in innovation culture and innovation capability as follows: 1 (Poor), 2 (Fair), 3 (Good), 4 (Very Good), 5 (Excellent), 0 (I don't know). Appendix B represents the survey questions.

5.2.2.1. Variables for innovation barriers

Innovation barriers were surveyed regarding each category implied by EOGI barrier model. The barriers aim to reflect such barriers that especially large and established industrial organizations commonly encounter. Appendix B represents the surveyed barrier items.

5.2.2.2. Variables for innovation capability

The selected items for innovation capability account the outcomes of dynamic capabilities from general perspective (part 3.1). Because innovation capability can be defined broadly as the ability to *routinely* achieve innovative outcomes, irrespectively of the form or type of innovation, the following six variables are seen to represent this desired aim.

Table 4. *Selected variables for measuring innovation capability*

Measured variable	Capacity (Wang & Ahmed, 2007)
(1) *Organizational agility*	Adaptive, Absorptive
(2) *Ability to learn from failures*	Adaptive, Absorptive
(3) *Sensitivity to technological changes*	Absorptive, Innovative
(4) *Market-technology linking performance*	Innovative
(5) *Interdepartmental linking*	Innovative
(6) *Visionary leaders*.	Adaptive, Absorptive, Innovative

Literature has identified certain areas that influence innovation capability positively. For example, innovation capability is enabled by necessary organizational structures that form the framework for innovation (Loewe & Dominquini, 2006). One key enabler is appropriate leadership, that is, visionary leadership. Secondly, ability to learn from failures represent the ability to change current practices when continuous problems are encountered (Hall & Martin, 2005). Arguably, strong dynamic capabilities would address these concerns quickly (Teece, 2018). Thirdly, organizational agility represents the essential core of dynamic capabilities: are resources deployed when they are needed, and where they are needed the most? (Teece, 2018) Moreover, can the organization spot those opportunities and enact with the required speed? Fourth, sensitivity to technological changes represents the adaptive capacity: can the organization sense actively the competitive environment, and find new opportunities? (Wang & Ahmed, 2007) Fifth, as innovation is arguably an interdisciplinary field, interdepartmental linking aims to measure if the organization leverages its assets at full power. Does the organization work in siloes with little interactions, limiting exchange of ideas and competence? (Shultz, 2003) Sixth, market-technology linking capability represents the overall innovative capacity to benefit from existing knowledge to provide solutions that current or potential customers either need or will need in the future.

5.2.2.3. Variables for innovation culture

Innovation culture was measured by three variables, namely *psychological safety, participative safety,* and *openness to new ideas.* These variables were seen to represent the major elements of innovation culture with reasonably accuracy (part 3.3).

5.3. Research process

The research started by drafting appropriate survey questions regarding *innovation barriers* (part 3.4)*, dynamic capabilities* (part 3.1)*, innovation capability* (part 3.2) and *innovation culture* (part 3.3). Full list of the survey items in appendix B. Cross-search capable database sources such as Scopus and Web of Science were used during the literature review for finding relevant articles in the field. Researchgate.net was used as a complementary source for ideas and thoughts made by other scholars and researchers. In help for SEM methodology, statistical fit indices, and macros of Statwiki[2] based on the work of Hair et al.

[2] http://statwiki.kolobkreations.com/index.php?title=Main_Page

(2010) were benefited. The survey was sent to all geographical business regions. The answers were treated as a homogenous group, which can be considered as one limitation of the study. The data was extracted into a statistical analysis software SPSS. Normal data cleaning operations were performed by eliminating unengaged respondents and imputing missing data. Large share of the data had to be excluded from the analysis for either not belonging to target group (manager without staff) or other data quality related issues. According to the best practices of SEM, research requires validation of the underlying theory by conducting first an Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Exploratory factor analysis (EFA) was done to collapse a large number of barrier variables into a few interpretable underlying factors. The compression was done by grouping the barriers into latent (unobserved) factors based on their joint probability to move together. The chosen extraction method for that purpose was maximum likelihood method with varimax rotation. The factor pattern matrix was cleaned by removing items with absolute value factor loadings less than 0.4, and by excluding items without no observable loadings. Adjustments in the factor structure were made yet so that acceptable reliability and validity of the constructs was retained. The made modifications to the factor structure are represented in Appendix D. After the model was found to represent adequate model fit for full data, further statistical tests were performed in IBM AMOS, SPSS, and Excel to validate that the model fit was adequate across the two measured levels; managers (group 1) and employees (group 2). Once clarity was reached that the models were identical in terms of factorial structure, hypotheses for the study were made. Regression analyses were then performed to either confirm or reject each null hypothesis.

5.4. Data

Altogether 271 respondents completed the survey. 192 of them (70,8 %) were included in the analysis due missing data, outliers, unengaged responses, or wrong categorization (manager without staff). Most of the respondents (88 %) were coming from EU area. Out of the total respondents, 84 was managers with staff responsibilities and 106 employees. In total, 172 qualified respondents completed the survey without any *don't know / cannot say* answers. Altogether 20 respondents' data was imputed due missing data. The background information included questions regarding experience within the company and experience outside the company. Three respondents did not imply their experience. Figure 10 and Figure 11 illustrate the distribution across these categories by respondents so that mean value represents the ordinal class.

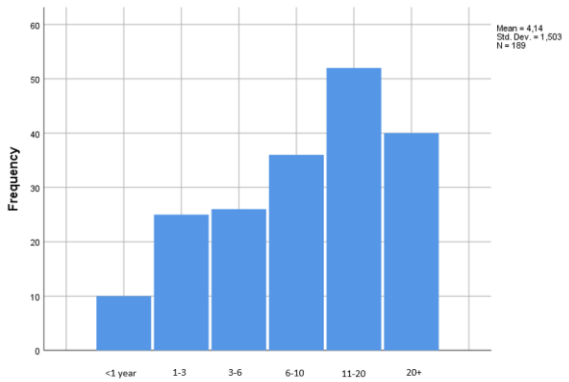


Figure 10. *Respondents' experience within the company (in years)*

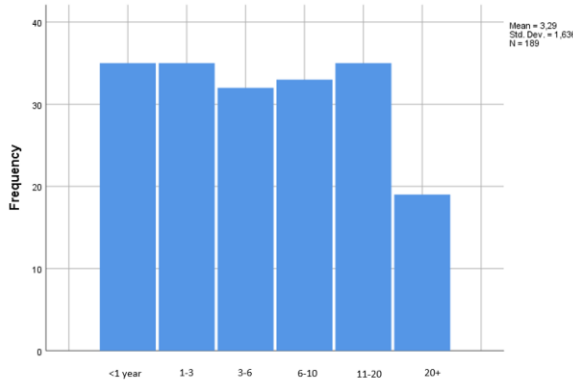


Figure 11. *Respondents experience outside the company (in years)*

Three outliers and five unengaged respondents were removed. Outliers and unengaged respondents were found by counting the gross number of each scale items from each respondents' responses. Those respondents who had no variation in their answers were removed (3 respondents). For the missing data, respondents with total over four "don't know/ cannot say" answers in either in independent variables (barriers, culture) or dependent variable (performance) were removed (49 respondents). These respondents were identified coming mainly from group 2 (employees) with mainly supportive tasks (e.g. customer service, information systems). Respectively, the experience varied from all employment duration categories from less than a year up to more than twenty years. This seemed to be logical because back-office administrative employees often have distant relationship to innovation with little to say "how things go around" in innovation. It also revealed that the survey was difficult to answer. Table 5 represents the response distribution across barriers variables (34 items) and performance variables (6 items). Altogether 12.2 % of answers were know option.

Table 5*. Frequency distribution of responses for barriers*

$ Frequencies			
		Responses	
		N	Percent
Barrier_series_response_frequencies[a]	Don't know/Cannot say	1708	12,2%
	Strongly disagree	829	5,9%
	Disagree	2632	18,8%
	Neither agree nor disagree	3142	22,4%
	Agree	4105	29,3%
	Strongly agree	1592	11,4%
Total		14008	100,0%

a. Group

All the “don’t’ know / cannot say” answers were treated as missing values. Because structural equation models are observed to be highly sensitive to sample size and require complete data, it was decided to increase the n from 172 fully completed respondents by imputing the missing values. Altogether 20 respondents’ values were imputed, increasing the *n* to 192. The missing values were found to be evenly distributed across questions. Culture variable was complete with this data set and did not need imputation. The data imputation done by using the median value of the questionnaire item of the total respondents.

5.5. Measures

Varimax oblique rotation method was used to produce correlation pattern matrix. SEM literature provides several cut-off criteria and model fit indices that were followed in this study to evaluate the validity and reliability of the study. Comrey and Lee (1992) suggest that sample size of 50 is very bad, 100 poor, 200 fair, 300 good, 500 very good, and 1000 excellent (Hair et al. 1998). However, it is noteworthy that the extant SEM literature lacks commonly agreed criterion. Following fit indices suggested by Hu & Bentler (1999) were used to evaluate model fit TLI, CFI, NFI, PCFI, GFI, AGFI, RMSEA. Considering the exploratory nature of the research, the model fit indices are considered to provide only acceptable or poor fit rather than good fit. Appendix C represents the found model fit indices and suggested cut-off criteria.

6. Results

The research aimed to explore the relationship between innovation barriers, innovation culture, and innovation capability. Two major latent barrier constructs were identified from the data. These factors were named (1) *Leadership barriers* and (2) *Organizational barriers.* The size of effect and significance of each barrier were found to be dependent on the hierarchical role. It was further found that innovation culture had positive and statistically significant effect on innovation capability, and that innovation culture moderated the negative effect of some barriers.

6.1. Factor analysis

Exploratory Factor Analysis identified underlying response patterns from the data. The barrier groups were named to (1) *Leadership barriers* and (2) *Organizational barriers* that

are explained below. The reliability and validity was assured by following the generally proposed thresholds for composite reliability (CR), average variance extracted (AVE), and maximum shared variance (MSV) (Hu & Bentler, 1999). Appendix B presents the results of factor analysis with respective factor loadings. The reduction of factors was done by suppressing smaller loadings than 0.4 and by iteratively removing constructs that either cross-loaded strongly or did not load well on any factor.

Leadership barriers

Leadership barriers included two second-order constructs, namely *Management,* and *Organizational focus.* Management construct included variables that related to management practices; Organizational focus included variables that related to organizational priorities and orientation towards change.

Organizational barriers

Organizational barriers included three second-order constructs that were *Resources*, *Innovation process*, *Incentives.* Resources construct included barriers that related to use and availability of resources (financial and personnel); Process barriers included factors that hampered flow of ideas; and Incentives included barriers that discouraged innovative behavior.

Culture

Innovation culture included variables relating to psychological safety, participative safety, and openness to new ideas.

Innovation capability

Innovation capability included variables that reflected the outcomes of dynamic capabilities - organizational agility, ability to learn from failures, market-technology linking capability, sensitivity to technological changes, interdepartmental linking, and visionary leaders.

6.2. Structural model

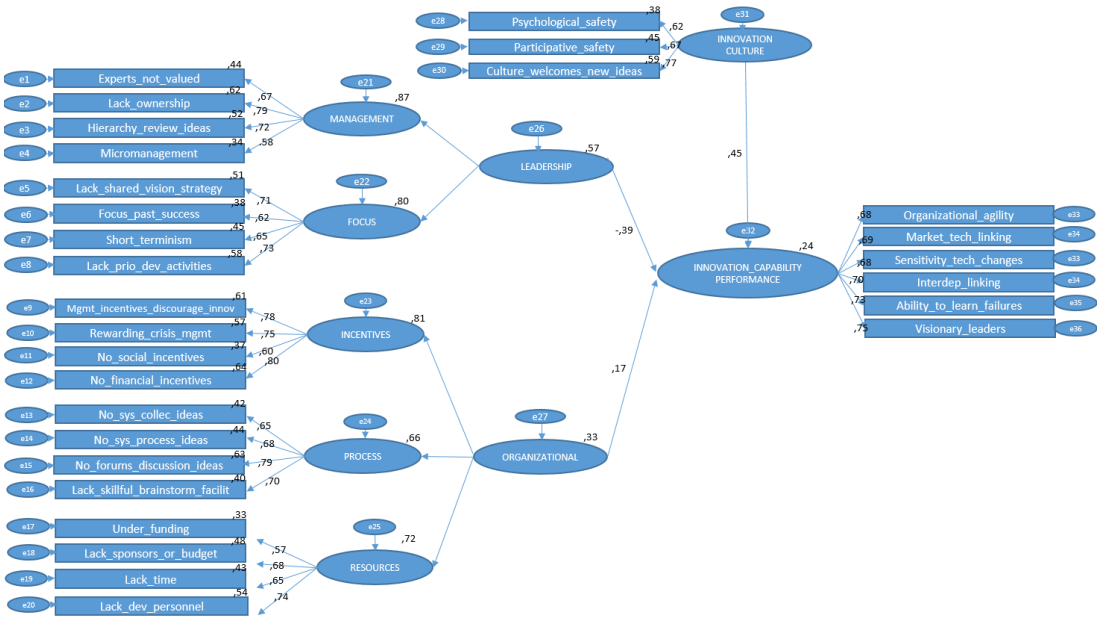
Table 6 illustrates that Fornell-Lacker criterion (1981) was established: no convergent validity or discriminant validity issues were detected when CR > AVE (Hair et al. 1998).

Table 6. *Discriminant validity and convergent validity*

	CR	AVE	MSV	MaxR(H)	PERF	LEADERSHIP	CULTURE	ORGANIZATIONAL
PERF	0,859	0,503	0,333	0,860	**0,709**			
LEADERSHIP	0,925	0,861	0,721	0,935	-0,467	**0,928**		
CULTURE	0,774	0,534	0,333	0,778	0,577	-0,556	**0,731**	
ORGANIZATIONAL	0,891	0,732	0,721	0,904	-0,411	0,849	-0,365	**0,856**

Figure 6 illustrates the structural model with the respective factor loadings of each construct. The model fit was considered adequate with following fit indices of $\chi 2$ /df = 2,057; RMSEA = 0.062; CFI = 0.89; TLI = 0.878; PCLOSE = 0.01. Although CFI and TLI were less than generally proposed above 0.9 rule (e.g. Hu & Bentler, 1999; Baumgartner & Homburg 1995) and hence not met, exploratory research has sometimes allowed to have lower fit indices. For example, Carlson & Muhlaik, (1993) suggest that above 0.85 is acceptable if research is exploratory by nature.

It is notable that no second order factor structure is in favor of researchers. However, given the aim of finding structural relationships and reflecting differences across groups, categorizing the barriers into two main constructs was found to increase the explained variance on dependent variable and hence being useful for high-level analysis. This allowed simple conclusions to be made by enabling better interpretability of the effects but as a trade-off decreased granularity.



χ 2 /df = 2,057; RMSEA = 0.062; CFI = 0.89; TLI = 0.878; PCLOSE = 0.01

Figure 6. *Factor structure, factor loadings, and fit indices for the structural model*

A model fit comparison between both groups as measured by $\chi 2$ test revealed that the factor structure for both groups were found to be invariant. This was done by comparing unconstrained model to a fully constrained model across both groups. The finding suggested that the number of factors and the pattern of factor-indicator relationships were identical across both measured groups. Table 6 represents the configural invariance test.

***Table** 7. Configural invariance test*

	Chi-square	df	p-val	Invariant
Overall Model				
Unconstrained	1158	710		
Fully constrained	1178,5	739		
Number of groups		2		
Difference	20,5	29	0,877	YES

***Table 8.** Metric invariance test*

	Chi-square	df	p-val	Invariant
Overall Model				
Unconstrained	1158	710		
Fully constrained	784,4	369		
Number of groups		2		
Difference	409,6	341	0,06	NO

Metric invariance test was conducted to find if the path-level coefficiencies had statistically significant differences for the found factors' loadings. Table 8 reveals that the path-level effects were different at statistically significant level across the groups.

6.3. Hypotheses

The effects of each innovation barrier category were hypothesized to cause lower innovation capability. The size of effect, direction, and significance was argued to be depending on the organizational role. Figure 12 illustrates the made hypotheses based upon the structural model (Figure 6. p.37).

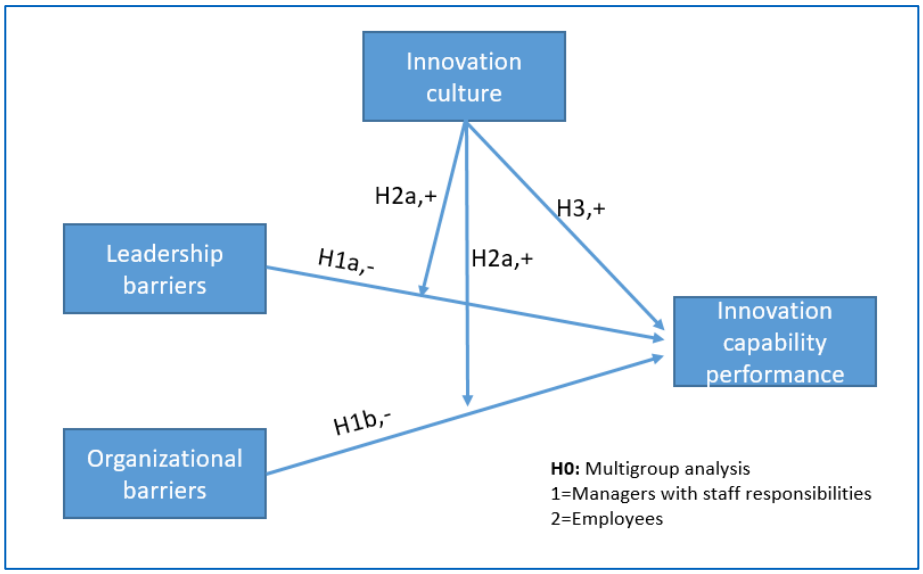


***Figure 12**. Hypotheses*

Altogether four hypothesis are drawn:

H0: *Innovation barriers have similar effect on innovation capability across hierarchical layers (managers and employees).*

- The idea is that if any differences exist, it offers better understanding on the mechanisms through which higher innovation capability can be achieved, and what kind of limiting factors each group perceive.

H1a: *Leadership barriers have negative effect on innovation capability.*

H1b: *Organizational barriers have negative effect on innovation capability.*

- The idea is that if such negative relationship between innovation barriers and innovation capability is found, both perceived and real-life (measurable) innovation capability can be enhanced by minimizing the distortions caused by potential barriers.

Direct positive effect of culture:

H2: *Innovation culture has a direct positive effect on the innovation capability.*

- Innovation literature has identified positive relationship between innovation culture and innovation capability. The idea is to replicate these findings. The findings should be similar across hierarchical groups

Moderated effect of culture:

H3a: *Innovation culture dampens the negative relationship between leadership barriers and innovation capability.*

H3b: *Innovation culture dampens the negative relationship between organizational barriers and innovation capability*.

- The idea is that if such moderating effect between the found barriers and innovation capability exists, innovation capability can be enhanced by reinforcing factors affecting positive innovation culture. This finding would be in line with the previous innovation research that links innovation culture into greater innovative performance of organizations (e.g. Hilmarsson et al. 2011; Zhang et al. 2018) which however has remained ambiguous. Rather than only providing evidence that links positive culture to directly to innovative performance, innovation culture would be seen as a mechanisms that dampens the negative effect of innovation barriers.

6.4. Findings

The study found that:

i) Two latent factors were found hampering innovation. Each barrier construct carried a systematic and negative effect on innovation capability.

ii) Managers and employees viewed the direction of the found innovation barriers on innovation capability conversely.

iii) From employees' viewpoint, leadership barriers had negative effect on innovation capability.

iv) From managers' viewpoint, organizational barriers had negative effect on innovation capability.

v) Innovation culture had direct and positive effect on innovation capability, irrespectively of the role.

vi) Innovation culture reduced the negative effect of leadership barriers for employees.

vii) Statistically significant difference in perceived innovation culture between the groups existed.

6.4.1. Employees

Table 9 represents regression analysis for employees. It reveals that employees were associated with very strong statistical significance (p = 0.001) that leadership barriers had negative effect (β = -0.406) on innovation capability. The effect of organizational barriers was non-significant, albeit negative. This model had R^2 value of 0.219, accounting 21.9 % variance in innovation capability.

Table 9. *Direct effects of barrier constructs on innovation capability for employees*

Model		Unstandardized B	Std. Error	Standardized Coefficients Beta	t	Sig.
1A	(Constant)	,104	,090		1,150	,253
	ZLEADERSHIP	-,406	,119	-,442	-3,403	,001***
	ZORGANIZATIONAL	-,032	,124	-,033	-,255	,799

a. Dependent Variable: ZInnovation_capability_performance

b. Predictors: Leadership barriers and organizational barriers

c. Selecting only cases for which POSITION = 3,00 **Non-managerial position**

d. *N* = 106

e. R^2 = 0,219

Another model for employees was tested by including culture. Table 10 shows the result of regression test. It was found that when culture was included, the R^2 value increased from 0.219 to 0.412. It was further observed that innovation culture had highly significant (p < 0.001) and direct positive effect (β = 0.464) on innovation capability. The effect of leadership barriers decreased from β = -0.406 to β = -0.199, and that the effect of organizational barriers decreased from -0.032 to +0.02. At this point, leadership barriers were no longer statistically significant, but showed strong evidence of negative effect (p = 0.073).

Table 10. *Direct effects of innovation culture and barrier constructs on innovation capability for employees*

Model		Unstandardized B	Std. Error	Standardized Coefficients Beta	t	Sig.
1B	(Constant)	,164	,079		2,063	,042*
	ZCULTURE	,464	,080	,507	5,786	,000***
	ZLEADERSHIP	-,199	,110	-,217	-1,811	,073
	ZORGANIZATIONAL	,002	,108	,002	,015	,988

a. Dependent Variable: ZInnovation_capability_performance

b. Selecting only cases for which POSITION = **3,00 Non-managerial position**

c. N = 106

d. R^2 = 0,412

The results suggested a possible moderating effect through culture. To test this effect, another model-level regression was performed. The standardized value of leadership barriers was multiplied with the moderating variable (culture) to find the direction and significance of the possible interaction effect. Table 11 shows that the interaction term was positive and significant at level p = 0.001. The possible moderation was further examined by performing F-test across two models (1) a model with the moderator variable and (2) without the moderator variable. Table 12 shows the results of the F-test.

Table 11. *Test for potential moderating effect of innovation culture for leadership barriers, employees*

Model		Unstandardized B	Std. Error	Standardized Coefficients Beta	t	Sig.
1C	(Constant)	,249	,094		2,657	,009***
	ZLEADERSHIP	-,470	,077	-,513	-6,139	,000***
	Leadership_x_culture	,227	,066	,289	3,465	,001***

a. Dependent Variable: ZInnovation_capability_performance

b. Selecting only cases for which POSITION = **3,00 Non-managerial position**

c. N = 106

d. R^2 = 0,300

Table 12. *F test for moderating effect of innovation culture*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	,467[a]	,218	,211	,91401609	,218	29,022	1	104	,000***
2	,548[b]	,300	,286	,86918704	,082	12,004	1	103	,001**

a. Dependent Variable: ZInnovation_capability_performance

b. Selecting only cases for which POSITION = **3,00 Non-managerial position**

c. N = 106

The results suggest that as the F-value change was highly significant ($p < 0.001$), and that the explained variance of the model increased, the moderating effect of culture for leadership

barriers for employees was statistically significant. The findings suggest that the effect of leadership barriers can be lowered by enhancing culture of innovation.

A new model was created that accounted both barrier constructs as well as innovation culture. Table 13 illustrates the β coefficiencies for innovation culture, leadership barriers, organizational barriers, and the interaction term. The model could explain 41.8 % in variance in innovation capability where culture had direct and significant ($p < 0.001$) positive effect ($\beta = 0.417$) on innovation capability, leadership barriers had significant ($p < 0.05$) and negative effect ($\beta = -0.226$) on innovation capability, organizational barriers had no effect on innovation capability, and that leadership barriers are moderated by innovation culture ($\beta = +0.071$). Figure 13 (p. 45) illustrates the moderating effect graphically.

Table 13. *Regression coefficiences and their significances for employees*

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1E	(Constant)	,201	,087		2,295	,024**
	ZCULTURE	,417	,093	,455	4,482	,000***
	ZLEADERSHIP	-,226	,113	-,247	-2,000	,048*
	ZORGANIZATIONAL	-,011	,109	-,012	-,105	,917
	Leadership_x_culture	,071	,070	,090	1,008	,316

a. Dependent Variable: ZInnovation_capability_performance

b. Selecting only cases for which POSITION = 3,00 **Non-managerial position**

c. N = 106

d. R square = 0,418

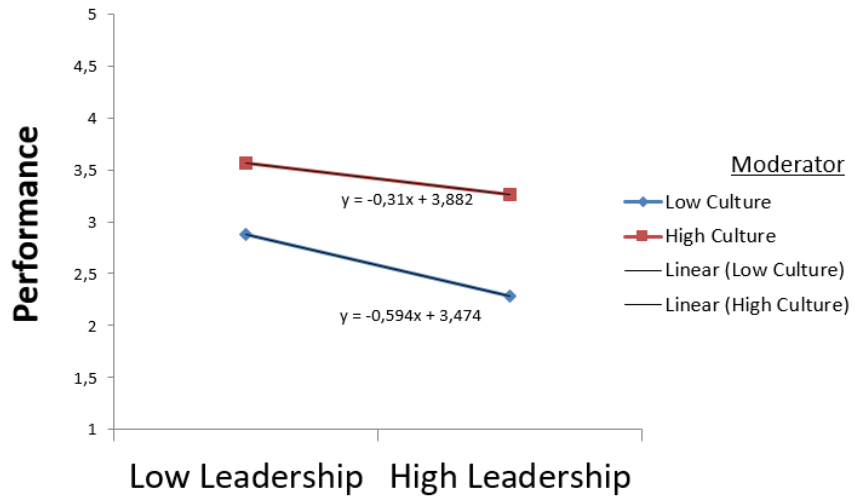


Figure 13.*Moderating effect of innovation culture between leadership barriers and innovation capability for employees*

6.4.2. Managers

Equal tests were performed for managers. Table 14 shows the results without accounting innovation culture. The effects of barriers were found to be the opposite than for employees. For managers, the effect of leadership barriers was highly insignificant ($p = 0.131$) and positive ($\beta = +0.200$), whereas organizational barriers showed significant ($p = 0.03$) and negative effect on innovation capability ($\beta = -0.381$). The model without innovation culture had R^2 value of 0.139.

Table 14. *Direct effects of barrier constructs on innovation capability for managers*

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
2A	(Constant)	,090	,104		,864	,390
	ZLEADERSHIP	,078	,131	,078	,595	,553
	ZORGANIZATIONAL	-,405	,128	-,416	-3,158	,002**

a. Dependent Variable: ZInnovation_capability_performance

b. Selecting only cases for which POSITION = 1,00 **Managerial position with staff responsibilities**

c. N **=**86

d.R^2 = 0.139

Table 15. *Direct effects of innovation culture and barrier constructs on innovation capability for managers*

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
2B	(Constant)	,024	,102		,236	,814
	ZCULTURE	,377	,125	,327	3,009	,004**
	ZLEADERSHIP	,200	,131	,202	1,526	,131
	ZORGANIZATIONAL	-,381	,123	-,391	-3,105	,003**

a. Dependent Variable: ZInnovation_capability_performance

b. Selecting only cases for which POSITION = 1,00 **Managerial position with staff responsibilities**

c. N = 86

d.R^2 = 0.226

Table 15 shows the results for managers when culture was added in the model. The R^2 value increased from 0.139 to 0.226. Table 15 suggests direct, and significant ($p = 0.004$) positive effect ($\beta = 0.374$) of innovation culture on innovation capability. The effect of leadership

barriers was found to be positive but statistically insignificant (p =0.131). Organizational barriers were found to have direct and significant (p = 0.003) negative effect on innovation capability (β = -0.381).

The possible moderation effect of culture for organizational barriers was tested. Table 16 represents the performed regression test for finding evidence of moderating effect of innovation culture to organizational barriers for managers. The standardized value of organizational barriers was multiplied with the standardized value of innovation culture. It was found that the effect for the moderation interaction term was not statistically significant (p = 0.142) but the effect of barriers to innovation capability effect decreased from -0.293 to -0.151. Table 16 suggests that that innovation culture has no statistically significant moderating effect between innovation barriers and innovation capability for managers.

Table 16. *Test for potential moderating effect of innovation culture for organizational barriers, managers*

Model		Unstandardized B	Std. Error	Standardized Coefficients Beta	t	Sig.
2C	(Constant)	,037	,105		,356	,723
	ZORGANIZATIONAL	-,293	,109	-,301	-2,697	,009**
	Organizational_x_culture	-,151	,101	-,165	-1,484	,142

a. Dependent Variable: ZInnovation_capability_performance

b. Selecting only cases for which POSITION = 1,00 Managerial position with staff responsibilities

c. n = 86

d. R^2 = 0.204

To illustrate the effects of each independent variable, another model was created for managers. Table 17 shows that innovation culture had direct and significant (p = 0.02) positive effect (β = +0.396) on innovation capability, and organizational barriers had statistically significant (p = 0.022) and negative effect (β = -0.301) on innovation capability. Culture was not observed to dampen the negative effect of barriers reliably. The R-squared value for this model was 0.257, implying that 25.7 % of the performance could be explained with the proposed variables in the model.

Table 17*. Regression coefficiences and their significance for managers*

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
2D	(Constant)	-,028	,104		-,269	,788
	ZCULTURE	,396	,124	,345	3,200	,002**
	ZLEADERSHIP	,202	,129	,203	1,560	,123
	ZORGANIZATIONAL	-,301	,129	-,308	-2,335	,022**
	Organizational_x_culture	-,176	,097	-,194	-1,821	,072

a. Dependent Variable: ZInnovation_capability_performance

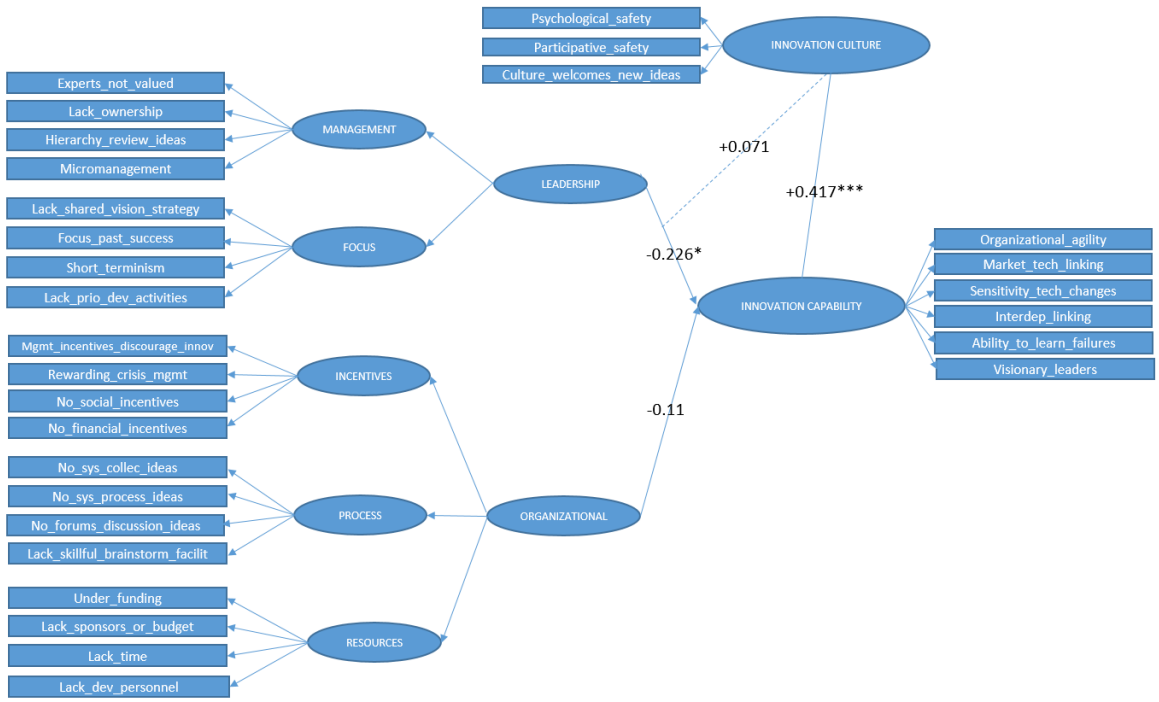
b. Selecting only cases for which POSITION = 1,00 **Managerial position with staff responsibilities**

c. n = 86

d. R^2 = 0.257

6.4.3. Synthesis

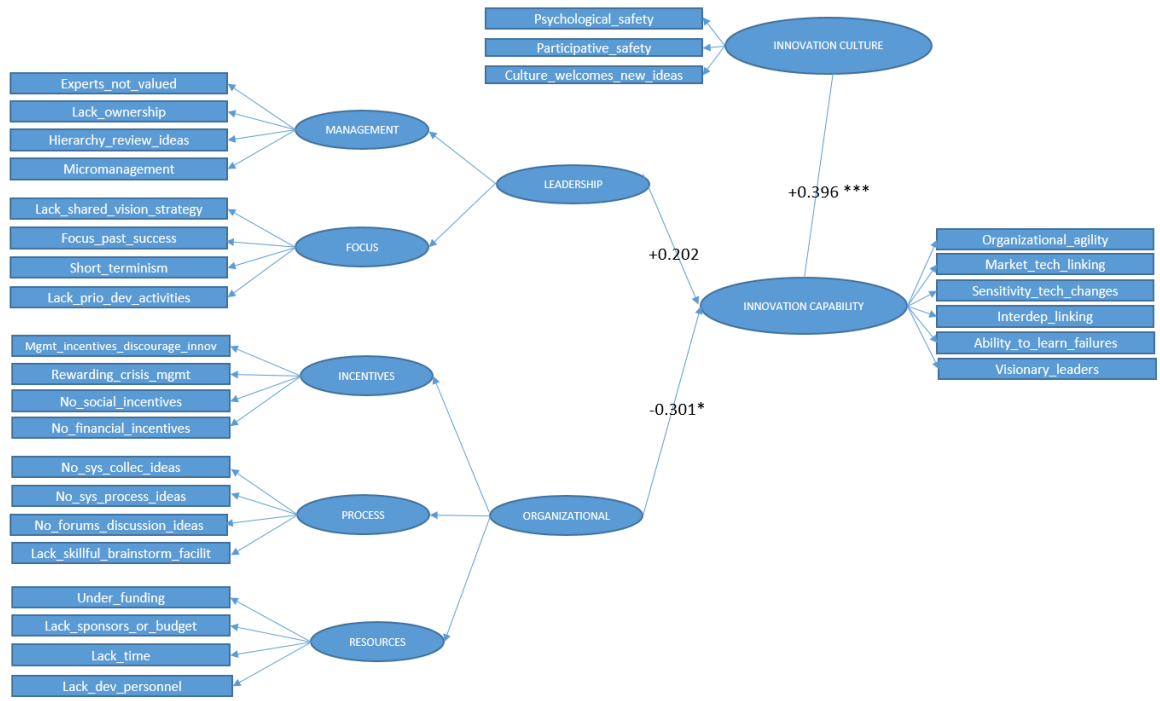
Based on the above results, graphical illustrations for each groups were drawn. Figure 14 illustrates that for employees, innovation culture had direct and positive effect on innovation capability; leadership barriers had negative effect on innovation capability; and that innovation culture dampened the negative effect of innovation barriers on innovation capability. The effects were statistically significant. The effect of barriers were controversial for managers. Figure 13 illustrates that innovation culture had direct and positive effect on innovation capability; organizational barriers had direct and negative effect on innovation capability; leadership barriers showed positive, although insignificant effect. The effect of organizational barriers were statistically significant. Independent samples t-test in appendix G1 and appendix G2 reveal further that innovation culture was perceived differently across the measured groups at statistically significant level in the following two variables: participative safety and psychological safety. The deviating results suggest that innovation capability can potentially be enhanced through different mechanisms, and that managers systematically rated innovation culture higher than employees did.



Stars represent statistical significance: * equals $p < 0.05$ and *** equals $p < 0.001$

The beta coefficient $-1 < \beta < 1$.

Figure 14. *Model for employees*



Stars represent statistical significance: * equals $p < 0.05$ and *** equals $p < 0.001$

The beta coefficient $-1 < \beta < 1$.

Figure 15. *Model for Managers*

7. Discussion

The results of this study were quite as expected. The found latent barrier factors had negative effects on innovation capability, and innovation culture had positive effect on innovation capability. However, the found statistical significances of the effects suggest that the found barriers for each group were prevailing rather than due random sampling error. The found systematic and negative effects necessitate further qualitative research to understand the phenomenon deeper. Consequently, managers of the studied organization shall ask why their employees feel systematically that their managers and leaders are not displaying the kind of behavior as they expect. Equally, it should be asked why the organizational constraints are prevailing. Is it just that these concerns are left without attention, or has something been purposefully left undone?

The study provides understanding that the effects indeed are systematic rather than opinions of fewer persons. This study can be thought as the initial step in identifying potential barriers and in organizing and managing innovation and change so that the barriers would be minimal. The results further suggest that improving and maintaining innovation culture might be a potential way to start increasing innovation capability through the found moderating effect among employees. In such case, employees would be involved in more intense discourse about the direction of the organization and prioritization plans. However, because culture alone cannot remove the found barriers, managers would need to start planning how to overcome the found organizational barriers.

The found differences across the groups were logical and intuitive. Because managers are different from their staff in their expected roles and outcomes, also the potential sources of barriers would intuitively be different between the groups. Although the structural models for each group did not have strong explanatory power in predicting innovation capability, the study gave insight on *how* the two groups were different, and what underlying latent factors affect innovation capability positively and negatively. However, rather than settling for the simple finding that the barriers that hamper innovation are subject to the hierarchical role, the method enabled to make data-driven conclusions about the possible underlying issues. Based on the findings of the found latent barrier factors, few possible investigation lines might help in understanding the underlying mechanisms through which the organization could expect its innovation capability to be improved.

The results suggest that employees seem to count more on their managers and leaders in aligning their organization with innovation by expecting them taking more responsibility

and ownership, and providing direction for the future - whereas managers seem to be limited by either organizational constraints or managerial capabilities. Two possible scenarios are likely to explain this controversy given that both groups share the same goal of improving and developing the organization. First, higher-order barriers might limit managers. The factor analysis suggest that rigid operational models, including funding models, ill-aligned performance management models, and process barriers can be one explanation that cause managers' inability to enact and drive for change. Lack of action would then show out as employees' dissatisfaction to current management and leadership style who clearly expect something different. Equally, it is possible that the upper echelons simply do not demand innovation and change with the intensity employees would think necessary. The second possible explanation is that managers with staff responsibilities would display poor levels of dynamic capabilities. The inability to enact would be then due low managerial performance to drive for change, and locate then in either of the dynamic capability areas – *sensing, seizing, or transforming.* The most likely area is transforming, because managers clearly feel that organizational barriers limit innovation capability.

7.1. Managerial implications

Although similar conclusions have been made in some recent managerial literature (e.g. Lean Startup) that innovation requires new type of leadership and that organizations are limited by their own contingencies, those subjective findings on the limiting factors have not, with best to the knowledge, been verified with priori academic quantitative research. The findings of the study shed light on two possible scenarios in identifying the possible root causes for lower innovation capability in the particular company.

Managerial awareness of the perceived differences across the hierarchies should not be underestimated. Because the study has measured "how things are" through the experiences of its organizational members it is very likely that there exists some grains of truth that would need managerial attention. Innovation capability can be potentially enhancing by aligning leadership and management better with innovation and change, and that the potential barriers could be overcome by providing managers the required freedom to operate and be provided with sufficient budgets which managers saw too low.

Scenario [A] – Higher-level constraints for managers

If organizational barriers cause lower innovation capability, managers may be constrained by higher-order barriers that limit their freedom to operate. Based on the factorial model,

such could be rigid funding models, ill-aligned performance management models, or process barriers. In such case, managers would be either unable to display the necessary and expected dynamic capabilities because their behavior is strongly tied into organizational constraints, such as lack of financial resources and personnel resources in projects they see necessary. Equally, upper echelons might limit middle managers' ability to drive for change due bureaucracy or lack of transparency of priorities. Clearly, more dialogue between various organizational layers would be needed to overcome the gap. However, managers might not be encouraged to do so because if they are measured from different things. Lack of time was clearly found hampering any developmental tasks as they would be added on regular work. This would lead into an agency issue simply by demanding less than what it is required. But given that managers are in key role in building dynamic capabilities so that "*the capability includes the capacity with which managers identify the need or opportunity for change, formulate a response to such a need or opportunity, and implement a course of action*" (Helfat et al., 2007, p. 2, Teece, 1997) it would be under managers' direct responsibility – irrespectively of the level - to start breaking down the potential innovation barriers once they emerge. This concerns any type of barrier whether it concerns organizational constraints or other misalignment such as ill-aligned performance management models. The organization should be mature enough to build the necessary forums to discuss about the underlying issues and self-organize around them to improve. In addition, higher-echelons would need to acknowledge that this requires as much resources as it takes and there is no room for bargaining, which managers saw a clear issue. The possibility of organizational barriers suggest also that more freedom to operate would be needed to improve the performance of dynamic capabilities *empowerment* facilitates the deployment of individual capabilities and enhance the influence of dynamic capabilities (Sprafke, 2014).

Scenario [B] – Low dynamic capabilities of managers

Because employees viewed that leadership barriers had systematic (i.e. statistically significant) and negative effect on innovation capability, the finding suggests that lower innovation capability is caused by leadership barriers. Accepting that innovation capability operates on dynamic capabilities, and which can be seen as the outcome of them (theoretical model presented in part 5.1) – one possible explanation for lower innovation capability is that managers display low levels of dynamic capabilities. In light of innovation literature, certain leadership and management traits have been found to have significant and positive effect on innovation, but which clearly have not translated into employees in the studied

organization. Although the cause-and-effect is difficult to prove, the finding is theory backed. While leadership barriers essentially represent how organization aligns itself to change, and how it manages change, employees systematically expect different role from their managers and leaders leadership style. This may be due (1) 'absolute' low performance, so that there exists inability to *search, seize,* and *transform* capabilities; (2) motivational factors in line with the EOGI barrier model individual level. For example, employees rated their managers' attitude towards change merely above three (Good) with relatively high standard deviation (1.07).

The finding that links cultural variables to reduce the negative effect of leadership barriers on innovation capability provides equally an opportunity to improve. The fact that there also existed a statistically significant difference in how innovation culture was perceived between the measured groups should not be overlooked. Because employees may not feel as strong innovation culture, two conclusions can be made from this: employees are in weaker position in bringing up their ideas or that employees are likely to want more transparency or discourse regarding the future, but are unable.

Implications for innovation management

Managers can see the theoretical model as proposed in part four as the necessary although initial step for improving innovation capability. This is enabled by (1) awareness of potential innovation barriers, (2) awareness of the concept of dynamic capabilities (3) understanding the role of innovation culture. By being able of the limiting factors as well as enablers, organizations can possibly start actions for aligning their organizations better with innovation goals. This includes not only making changes on the constructs of innovation capability, *leadership, culture, people and assets, processes and tools*, but also building the kind of dynamic capabilities that drive for change: adaptive, absorptive, and innovative capacities of managers (Wang & Ahmed, 2007) or *sensing, seizing, or transforming* (Teece, 2018). Understanding the differences in structural effects helps leaders to understand better what factors limit innovation, and what expectations various parts of the organization have regarding innovation. For example, upper echelons might not have provided the necessary freedom to operate, and managers lack proper negotiation opportunities for additional resources in pursue of overcoming existing challenges or pursuing for opportunities. Furthermore, managers might be poorly incentivized taking calculated risks which necessitate critical view to performance management models – not just financial ones but also social recognitions.

Innovation culture was found to have a significant and positive effect on innovation capability across both groups. The finding confirms that innovation culture is important element in innovation management. This needs attention of managers and leaders because would have to embedded in organizational values. However, the responsibility of this area is yet to be solved: is it the common responsibility of managers and leaders, or can for example HR intervene to the found differences across groups? It was an interesting finding that there was a statistically significant difference in perceived innovation culture between employees and managers: while managers rated cultural variables culture attributes higher, employees did not perceive as strong innovation culture as good as their managers did. Consequently, it should be asked if hierarchical authority suppress innovation culture? Are some members more socially recognized to bring up issues? Managers and employees are arguably together responsible for maintaining favorable culture through their actions, but managers should acknowledge that the culture is more likely to be framed through managerial actions. Either or so, the results suggest that innovation capability might potentially be enhanced by improving innovation culture, but which as for currently is not favorable in terms of world-class measures (e.g. above four).

The data suggests that while employees seem to account for managers and leaders for providing direction and ownership, managers and leaders seem to count more for the organization. Managers should then start exploring how innovation and organizational renewal would become an active and interactive process of learning, where organizational members can contribute at all levels. It is clear that employees wish more transparency and discourse from upper echelons because innovation culture was found to moderate the negative effect on leadership barriers. Moreover, the fact that there exists statistically significant, i.e. systematic difference in how strong innovation culture is perceived implies some challenges. Overcoming the barriers would need in either of the scenarios critical inspection to organizational structures, policies, and practices. With this regard, innovation literature seems to be proposing increasingly many new philosophies, organization models and structures that should be further researched, and their suitability evaluated for the company. However, the aim and intentions should be guided directly by higher-echelons who enable the change.

7.2. Theoretical implications and future research

The evidence from this empirical study suggests that:

(1) Managers and employees are likely to share different understanding on the effects of barriers on innovation capability,
(2) Innovation culture has direct and positive effect on innovation capability independently of the role, and that
(3) Favorable innovation culture may help to reduce the negative effect of innovation barriers on innovation capability.

The research has found exploratory evidence that various innovation barriers as measured by the perceptions of organizational members had negative effects on perceived innovation capability. The findings extend the current understanding of the relationship between innovation barriers, innovation culture and innovation capability that have remained fairly unstudied. The theoretical model proposed in part 5.1 is can be used in future research in analyzing and improving companies' innovation capability by acknowledging the role of dynamic capabilities. With best to the knowledge, the findings have remained completely unstudied within the current innovation literature. The evidence call for further research streams why such differences across the two hierarchical groups exist. Shouldn't there exist a consensus about the main barriers? Why the structural effects deviate? Although some differences are expected due difference in roles between employees and managers, I believe that the better consensus there would exist regarding the main barriers, the better would the organizations perform by having established shared understanding on what hampers innovation.

A possible way to start examining these differences further would be to follow the proposed theoretical framework of the study (chapter four) and divide innovation capability into dynamic capabilities, for example, as suggested by Wang & Ahmed (2007) into three capacities that were *adaptive capacity, absorptive capacity*, and *innovative capacity* or equally capabilities defined by Teece (2018) *sensing, seizing, or transforming.* These capacities – or capabilities - should be then split into smaller and more granular items that would represent each capacity. Research should then aim to find the effect of each barrier for each capacity, and factorial analysis could be replicated with the similar model as proposed in part 5.1. Those findings would help to differentiate the effect of each barrier on

each dynamic capability construct and increase level of details in analysis. For non-academics, the results would help organizations to align their innovation goals by identifying the limiting factors by defining more accurately the underlying influence mechanisms of the found barriers. These findings would then help to take corrective actions what hampers innovation from both dynamic capability and innovation capability perspective, and the findings would help to differentiate in which capacity organizations are facing most difficulties.

The findings of the study support the claims in literature that innovation culture is beneficial to innovation (Hilmarsson et al. 2011). The relationship between innovation culture and innovation capability was analyzed through direct and indirect effects. The evidence confirms that there exists direct and significant positive effect between innovation culture and innovation capability, and that the effects exist independently of the organizational role. The research has also answered on the call for paying more attention to the process that links culture to outcomes (Zhang et al. 2018); innovation culture was found reduce the effect of innovation barriers. For employees, it is concluded that the effect of leadership barriers may be dampened through culture, but the same can occur for managers by accounting more cultural variables that would help managers in better identification of potential challenges. A possible explanation for the moderating effect is that once strong innovation culture exist, organizational members would be involved in more intense discourse about innovation goals and organizational priorities for change. Hence, transparency and minimal information asymmetries would align the organization better with innovation goals – across both organizational levels. Thus, the study proposes that greater innovative performance through culture may be achieved because open discourse would establish common direction across those who create the change (employees) and those who envision the change (managers).

The chosen research method Structural Equation Modeling (SEM) method was considered appropriate for measuring the effect of such constructs that are difficult to measure by single questionnaire items. Further research is encouraged to be done with similar method because innovation barriers remain relatively unstudied field (Hueske et al. 2014). Various perspectives are needed also from cultural viewpoint that would account cultural variables more comprehensively. Future studies with Structural Equation Modeling in similar settings would also help to understand the underlying interrelationships of various barrier constructs. For example, analysis could be performed to identify which barriers have the most critical effect to others? Arguably, focusing on critical paths, some barriers effect

could be mitigated to the others. Finally, because innovation barrier literature has been relatively scattered, the theoretical model proposed in this study (part 5.1.) may be a good starting point for new type of innovation research: the study opens up a possible research stream: what kind of barriers have most impact on innovation capability, and what cultural factors help reduce the effect of barriers? Such analysis could then be applied in finding which cultural factors are the most critical for aligning organizational members behavior around innovation, besides just being a widely declared value.

8. Conclusions

The study found empirical evidence that employees and managers may share different views on how innovation capability is limited and how it potentially be can improved. While employees seem to count more on their managers and leaders by displaying certain behavior, the managers seem to be limited by organizational constraints. The statistical significances suggest that the barriers are prevailing among each group, and cannot be overlooked. Further qualitative research should be made on each of the areas in order to confirm either, and to find other possible factors that potentially have negative effect on innovation capability that were not identified.

The study found that on one hand, innovation requires more commitment of managers and leaders but on the other hand the ability to enact. It may be that managers are limited due organizational factors, such as rigid operating models, performance management models, bureaucracy and policies. For example, rigid funding model might cause low ability to deploy new resources where they are needed the most, and poorly aligned incentive systems respectively cause agency issues causing lack of ownership. Alternatively, managers with staff responsibilities might display 'absolute' poor levels of dynamic capabilities in eyes of employees. In practice, this would mean that inability to enact is caused by poor capabilities, which respectively lead into high leadership barriers. However, as literature has suggested that managers are in key role in building dynamic capabilities that create innovation capability, managers must reflect why the results indicate what they do, and acknowledge that reinforcing this capability is an objective itself.

The study found also confirmative evidence for the proposed view in literature that certain cultural traits are beneficial to innovation; innovation culture has strong and statistically significant positive effect on innovation capability. Consequently, it is concluded that fostering favorable innovation culture is seen likely to lead better innovative performance through higher innovation capability. Additionally, as the potential mechanism through which innovation culture has positive effect on innovation has remained unexplored, the study tested a possible moderating effect of culture as suggested by Zhang et al. (2018) to find more evidence for culture performance studies how culture affect innovative performance. It was found that for employees, innovation culture moderated the negative effect of leadership barriers. For managers, there was not found statistically significant moderating effect. This finding, however, does not exclude that similar phenomenon would exist among managers, but which just did not come up as highly significant in the study.

To become successful innovator, must its' people be *willing* and *able* to innovate (Jong & Hartog, 2007). Consequently, organizations must align themselves with innovation both structurally and mentally and start breaking down barriers that may hamper innovation. If innovation is an acknowledged must, shall it not to be treated another *management theme du jour* given its importance. The results would indicate that employees want higher hierarchies to be more aligned with innovation goals by displaying visionary leadership and taking ownership of change. In addition, managers with staff responsibilities perceived various organizational barriers hampering innovation. Both of the proposed views need to be taken into account. Because also lack of forums in discussion prevailed among both groups, this leads to ask to what extent the exerted bureaucratic control is beneficial to innovation, regarding that dynamic capabilities can be limited due organizational factors? Are there other organizational forms that would better match with the required speed and change innovation economy necessitates? Research on these areas is gaining increasing attention, yet barrier perspective may be a promising one because overcoming each of the barriers is likely to lead into higher innovative performance.

9. Limitations

The found negative effects suggest that the studied organization could possibly improve its innovation capability by breaking down its potential barriers. For this purpose, the study proposed a framework that has not been tested in prior research. Exploratory research made in this study found evidence that various innovation barriers do exist from practical viewpoint and they have negative effect on innovation capability. However, the true effect of barriers is close to impossible to measure, and the effects were measured through *perceptions*. Structural Equation Modeling was seen a good starting point, which can account latent variables in analyzing structural effects. However, the findings of this single case study are not analytically generalizable, and yet need critical eye because the results may contain bias strong bias based on the organizational roles.

According to Tarka (2017), other critique against Structural Equation Modeling (SEM) methods often address pitfalls in mathematical formulation, weak external validity of models, as well as philosophical bias on inherent to the standard procedures. These concerns need to be discussed appropriately. Firstly, the theoretical model developed in the study is exploratory by nature. Hence, the study reflects the researcher's view on the most important innovation enablers and innovation barriers. Further research should be done to consolidate these fields to improve the proposed model (part 5.1.) and by altering it according to a more detailed model. Secondly, due the low R^2 values for each model the structural coefficients between the found factors must be considered only approximations, that is, the results imply that a relationship between leadership barriers and organizational barriers does exists but without full explanatory power in explaining all variance in innovation capability. However, the statistical significances in the effects were systematic, and cannot be hence simply be put aside and ignored. Thirdly, further research should be done to make broader generalizations more acceptable based on this study. Yet external validity of the developed theoretical model is not easily replicable, but including more variables is likely to increase reliability and validity of the proposed model through better R^2 values.

Innovation is a very broad topic. Numerous factors influence innovation capability both positively and negatively. The study gathered only a fraction of potential innovation barriers and innovation enablers. However, because innovation barrier research and innovation capability remain scattered in literature, the study can be viewed as the initial step in linking various innovation-related concepts that have positive and negative effect.

Further literature reviews would be needed to establish common agreement on the main factors. This would help to make future research more coherent and reliable. Similar studies could be performed with unified metrics, and the results could be discussed across industries. It would be interesting to see if the effect of barriers are relatively stronger compared in large companies compared to smaller companies.

Prior research has linked innovation culture higher innovative performance. Regarding the moderating effects, this study can be thought of as the initial attempt to do so. Hence, the study found confirmative evidence that innovation culture has positive effect on innovation capability, but the proposed moderating effect has not been empirically tested before. Similar research would needed as culture-performance studies lack of explanations how innovation culture is beneficial (Zhang et al. 2018).

Because each organization is unique, studying other companies other companies in contexts than high technology industry is likely to yield different results. Potential distortions to the data can be caused by country-specific cultural factors, for example, by reacting more strongly on some questions. However, as most of the respondents were from Europe (88 %) this potential effect is concluded not to cause significant difference in results. Regarding that Structural Equation Modeling aims to account variance in answer patterns, median imputation method artificially suppresses variance. A more suitable method for this would likely to have been KNN-algorithm because it would have retained variance. However, median imputation was selected because it was more intuitive and easier imputation method than KNN, reducing the risk of error. The selected imputation method can be interpreted to be one weakness of the study – but as the same the necessary trade-off to increase n, although low impact due low n of imputations (20).

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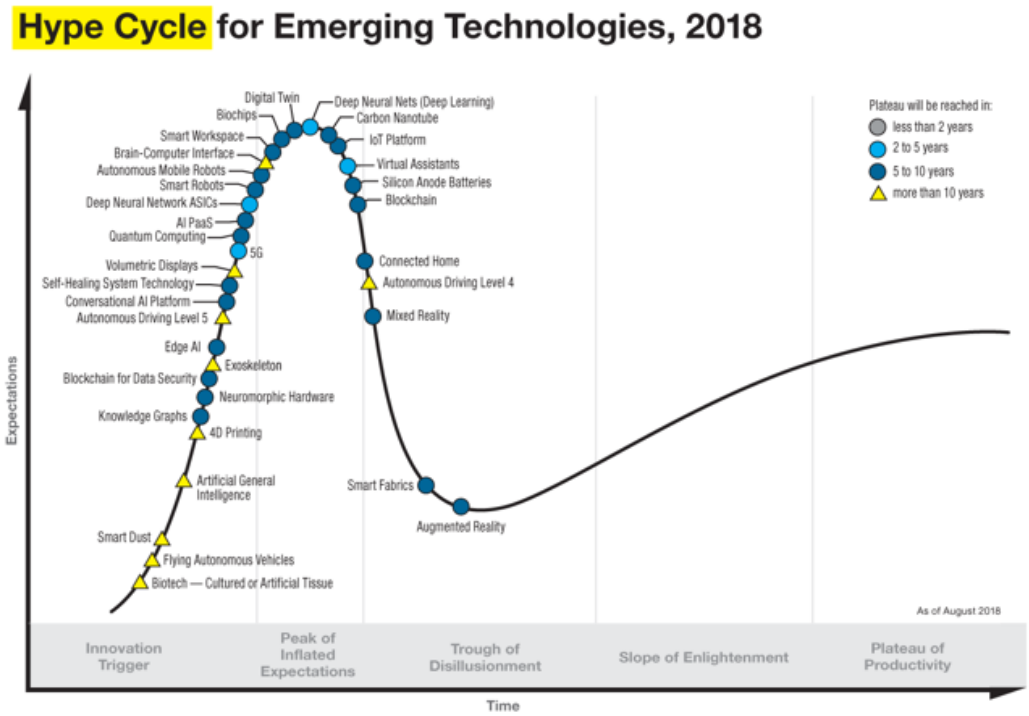
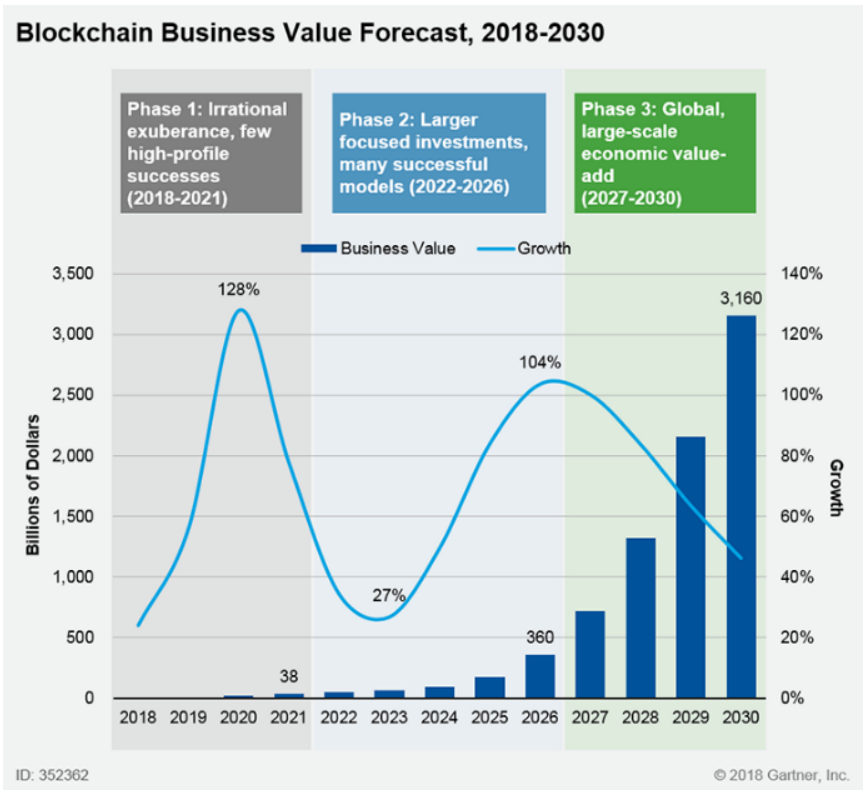
Appendix A: Technology Hype Cycle

Appendix A1: Gartners Hype Cycle for Emerging Technologies



Appendix A2. Example of Hype cycle evolution of one prominent technology – the Block chain



Appendix B: Survey items

Appendix B1: Survey items with their respective survey scale

Innovation barriers (Barrier)*	**Innovation culture (Enabler)****	**Innovation capability (Dependent variable)*****
Please evaluate the following barriers at your organization.	*How strongly do you agree with the following statements?*	*In relation to innovation, how do you rank the performance of the following?*
Lack of a shared vision, purpose and/or strategy	Our culture welcomes new ideas.	Organizational agility
Short-term thinking/targets	I feel encouraged to challenge decisions and actions if I think there is a better way.	Ability to learn from failing
Lack of priority in various organizational developmental activities	I can present my ideas without fear of being judged.	Positive attitude towards changes
Lack of ownership by leaders		Collaborative culture
Hierarchy over management and review of new ideas		Visionary leaders
Expert opinions are not valued		Safe-to-fail culture
It is difficult to find suitable specialists		Flexible and easy-to-use information systems / tools
Risk aversion / Belief that innovation is inherently risky		Personnel with superior technical expertise
Micromanagement		Sensitivity to technological changes
Internal process focus rather than external customer focus		Market-technology linking
No systematic collection of ideas		Interdepartmental linking
No process to handle innovative ideas		
Under-funding of new/innovative ideas		
Focus on successes of the past rather than the challenges of the future		
Management incentives are not structured to reward innovation		
No financial incentives to pursue for innovations		
No social incentives to pursue for innovation (e.g. public appraisal)		
Rewarding crisis management rather than crisis prevention		
Reluctancy of other individuals/teams/functions to share resources to help in		

implementation of innovative ideas		
Constantly shifting priorities		
Recruiting process is inefficient		
Fear that criticizing current practices and commitments involves personal risk		
Lack of understanding and interaction with the customer		
Lack of innovative ideas		
Lack of cooperation with external units (e.g. universities, companies, institutions)		
Lack of innovation sponsors (or budget)		
Lack of time		
Lack of development personnel (e.g. business developers, process developers)		
Lack of competent personnel		
Lack of skillful brainstorm facilitation		
No proper forums to discuss new/innovative ideas or organizational issues		
Supervisors/Managers do not listen new ideas		
Supervisors/Managers do not understand new ideas		
Results are expected sooner than is realistic		

*Barrier items were measured on a Likert scale (1-5)
(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree (4) Agree, (5) Strongly agree

**Innovation culture items were measured on a Likert scale (1-5)
(1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree (4) Agree, (5) Strongly agree

***innovation capability items were measured on a Likert scale (1-5)
(1) Poor, (2) Fair, (3) Good, (4) Very good, (5) Excellent

Appendix C: EFA Factor Analysis

Appendix C1: Exploratory Factor Analysis factor structure and modifications

	Factors				
	1	2	3	4	Operation
Lack_ownership	,680				2nd order construct: *management*
Rewarding_crisis_mgmt_over_proact	,621	,428			**Moved to factor 2 (Organizational), 2nd order construct incentives**
Lack_prio_dev_activity	,617				2nd order construct, *focus*
Hierarchy_review_ideas	,597				2nd order construct, *management*
Focus_past_success	,560				2nd order construct, *focus*
Short_terminism	,553				2nd order construct, *focus*
Incentives_not_rward_innov	,544	,490			**Moved to factor 2 (Organizational), 2nd order construct, incentives**
Experts_not_valued	,538				2nd order construct *management*
Lack_shared_vision_pur_strg	,536				2nd order construct, *focus*
Micromgmt	,472				2nd order construct, *management*
Lack_sponsors	,452	,381			**Moved to factor 2 (Organizational), 2nd order construct, resources**
Lack_time		,882			2nd order construct, *resources*
No_sys_process_ideas		,862			2nd order construct, *process*
No_sys_collection_ideas		,695			2nd order construct, *process*
No_financial_incent	,404	,568			2nd order construct, *process*
No_forums_for_discussion		,562			2nd order construct, *process*
No_social_incent	,435	,512			2nd order construct, *incentives*
Lack_skillful_brainstorm_facilt		,493			2nd order construct, *process*
Under_funding	,406	,480			2nd order construct, *resources*
Lack_dev_personnel		,400			2nd order construct, *resources*
Perf_agility			,751		
Perf_ability_to_learn			,716		
Perf_sensitivity_tech_chg			,656		
Perf_visionary_leaders			,655		
Perf_market_tech_linkg			,653		
Perf_interdep_linkg			,644		
Psychological saferty				,689	
Participative safety				,672	
culture_welcomes_new_ideas				,535	

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 9 iterations

Appendix C2. KMO and Bartlett's Test for factor structure

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		,905
Bartlett's Test of Sphericity	Approx. Chi-Square	6230,546
	df	946
	Sig.	,000

Appendix C3. Total Variance Explained by the factors

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13,901	28,960	28,960	6,154	12,822	12,822	5,963	12,422	12,422
2	4,461	9,294	38,254	8,934	18,612	31,434	5,441	11,334	23,757
3	2,562	5,337	43,591	3,783	7,882	39,316	4,633	9,652	33,408
4	2,130	4,437	48,029	1,517	3,160	42,475	2,941	6,128	39,536
5	1,649	3,435	51,463	1,419	2,955	45,431	2,141	4,460	43,996
6	1,396	2,909	54,373	1,202	2,505	47,936	1,492	3,108	47,105
7	1,271	2,649	57,021	,859	1,789	49,725	1,258	2,620	49,725
8	1,109	2,311	59,333						
9	1,046	2,180	61,513						
10	,980	2,043	63,555						
11	,928	1,934	65,489						

12	,861	1,795	67,284						
13	,818	1,705	68,988						
14	,776	1,617	70,605						
15	,757	1,576	72,181						
16	,726	1,513	73,695						
17	,687	1,432	75,127						
18	,661	1,377	76,504						
19	,649	1,352	77,857						
20	,624	1,300	79,156						
21	,589	1,227	80,383						
22	,574	1,196	81,579						
23	,546	1,138	82,717						
24	,525	1,095	83,811						
25	,512	1,068	84,879						
26	,504	1,049	85,928						
27	,487	1,015	86,943						
28	,480	,999	87,942						
29	,439	,916	88,858						
30	,431	,897	89,755						
31	,406	,846	90,601						
32	,393	,819	91,420						
33	,364	,758	92,178						
34	,351	,730	92,909						
35	,340	,708	93,617						
36	,322	,671	94,288						

37	,305	,636	94,925						
38	,294	,614	95,538						
39	,275	,574	96,112						
40	,265	,553	96,665						
41	,264	,549	97,214						
42	,248	,518	97,731						
43	,226	,471	98,203						
44	,223	,465	98,667						
45	,196	,408	99,075						
46	,172	,358	99,433						
47	,158	,328	99,761						
48	,115	,239	100,000						

Extraction Method: Maximum Likelihood.

Appendix C3: Communalities

Communalities

	Construct	Initial	Extraction
BARRIER (Leadership) *Focus*	FOCUS_construct=Lack_shared_vision_pur_strg+Focus_past_success+Short_terminism+Lack_prio_dev_activity	1,000	,658
BARRIER (Organizational) *Incentives*	INCENT_construct=Incentives_not_rward_innov+Rewarding_crisis_mgmt_over_proact+No_social_incent+No_financial_incent	1,000	,750
BARRIER (Organizational)	COMPUTE PROCESS_construct=No_sys_collection_ideas+No_sys_process_ideas+No_forums_for_discussion+Lack_skillful_brainstorm_facilt	1,000	,654
BARRIER (Organizational)	COMPUTE RESOURCES_construct=Under_funding+Lack_sponsors+Lack_time+Lack_dev_personnel	1,000	,726
ENABLER (Culture)	COMPUTE CULTURE=culture_welcomes_new_ideas+encouraged_to_challenge_decisions+non_judgemental_climate	1,000	,748
INNOVATION CAPABILITY	COMPUTE Innovation_capability_performance=Perf_agility+Perf_ability_to_learn+Perf_visionary_leaders+Perf_sensitivity_tech_chg+Perf_market_tech_linkg+Perf_interdep_linkg	1,000	,704

Extraction Method: Principal Component Analysis.

Appendix D: CFA Model Fit

Appendix D: Confirmatory Factor Analysis Model Fit results and suggestest fit indices

Index	Shorthand	Value	General rule for acceptable fit, if data are continuous (Hu & Bentler, 1999)
Absolute/predictive fit			
Chi square	x^2	712,14	
Degrees of freedom / Chi square	CMIN/DF	1,951	< 3
Comparative fit			
Tucker-Lewis index	TLI	0,891	0,90 for acceptance
Comparative fit index	CFI	0,902	0,90 for acceptance
Normed fit index	NFI	0,82	0,90 for acceptance
Parsimonius fit			
Parsimony-adjusted CFI	PCFI	0,811	0,90 for acceptance
Goodness of fit indices			
Goodness of fit index	GFI	0,851	0,90 for acceptance
Adjusted GFI	AGFI	0,822	0,90 for acceptance
Root mean square error of approximation	RMSEA	0,59	< 0.6 to 0.8

*Even though the values for GFI and AGFI do not exceed 0.9 (the threshold value), they still met the requirement suggested by Baumgartner and Homburg (1995), and Doll, Xia, and Torkzadeh (1994): the value is acceptable if above 0.8

**Carlson & Muhlaik, (1993) suggest that for CFI and TLI above 0.85 is acceptable considering the exploratory nature of the research.

Appendix E: CFA constructs, theoretical justifications

Appendix E1: Constructs with their theoretical justifications

Construct	Measures	Rationale	Source
Innovation culture			
	Psychological safety	Safe environment for interpersonal risk-taking increases number of attempts of introducing new ideas and innovations;	Edmonson & West (2008)
	Participative safety	Participative safety increases the amount of effort and quality of work	Edmonson & West (2008)
	Culture welcomes new ideas	Culture of innovation drives organization changing; Lack of innovation is not due lack of ideas but more of their implementation	Drobni (2008); Pinchot (1985)
Leadership barriers			
Management			
	Lack of ownership	Articulated and enacted support of leaders for innovation fosters innovation; Organizing and managing change is difficult because change is at the odds of administrative process of the past; Lack of support from higher hierarchies hamper innovation; difficulty to get top management support has significant negative effect to perceived innovative performance	Christensen (1997); Kanter (1982); Ali & Hadi (2012); Oke (2003)
	Hierarchy over review of ideas	Restrictive mindset discourage innovation; wrong forms of bureaucracy suppress creativity; hierarchy of authority stimulates conformity rather than innovation; innovative behavior is interpreted as unreliability	Aarikka-Stenroos (2018); Bart (2012); Thompson (1965)
	Expert opinions not valued	Collective mindset; lack of empowerment	Aarikka-Stenroos (2018); Totterdill & Exton (2014
Focus			
	Micromanagement	Systems and procedures that govern decision-making, resource allocation, performance and standard operating procedures must be aligned with commitment to empowerment and trust rather than reflecting centralized control and micro management	Totterdill & Exton (2014); Hadjimanolis (1999)
	Lack of shared vision, purpose and strategy	Lack of clear innovation and/or technology strategy is a major barrier to innovation; Lack of innovation strategy implies lack of priority in innovation; Innovation strategy helps to prioritize different projects; Lack of innovation strategy leads organization drifting from one ad-hoc decision into another; Lack of innovation strategy leads to misalignment of organizational structures with innovation	Cooper & Edgett (2015); Ren (2009); Mintzberg (1978)
	Focus on past successes rathen than challenges of the future	Developers are forced redefine new products as an established business; Incumbent's curse	Dougherty (1994); Eisenhardt & Martin (2000); Chandler & Tellis (2001)
	Short-terminism	Lack of commitment to long-term contracts; Organization is focused excessively on short-term results at the expense of long-term interests; Management that tries to maximize the market value of the firm (that is current price) tends to choose short-term projects; policy statements can enact as innovation barriers	Manso (2017); Storey (2000); Holmström (1989); Anderson & West (1998)
	Lack of priority in developmental activities	Lack of priority improve existing processes retain status quo. Engineers are occupied troubleshooting rather than engaging in developmental activities; many companies fail to follow Lean principles due excessive focus on waste while ignoring the improvement of value-add capacity	Ren (2009); Steinert et al. (2014)
Organizational barriers			
Resources			
	Lack of sponsor or innovation budget	Resources are not made available for innovation; lack of innovation gatekeeper can enact as a barrier;	Ren (2009); Cooper (1975); Daft (1968); Martini & Pellegrini (2005);
	Under funding innovative initiatives	Starved resources cause reluctancy to allocate funding and staff to projects managers perceive risky:	Soren Kaplan & Stu Winby (2007)
	Lack of development personnel	Lack of development personnel is a general barrier to improve existing processes	Hadjimanolis (1999);Ren (2009); Mueller (2012)
	Lack of time	Organizational slack has positive effect on technical innovation; shortage of time is a general barrier to innovation	Ren (2009); Mueller (2012)

Process			
	Lack of forums for discussion of innovative ideas	Lack of forums for discussing innovative ideas (or developmental areas) cause segmentalism; Segmentalism is ideal for not-invented here syndrome;	Schultz (2003); Drobni (2009)
	No systematic collection of ideas		Gordon (1961) (Synectics)
	No systematic process to handle innovative ideas	Lack of dynamic capabilities; Innovation process works under a framework of conditions that make the emergence of innovation more likely	Teece et al. (2016); Schultz (2003)
	Lack of skillful brainstorm facilitation	Skillfull brainstorming can facilitate divergent thinking necessary for creativity and innovation	Kalagiros & Manning (2015); Gordon (1961) (Synectics)
Incentives			
	Management incentives discourage innovation	Status quo is good enough; Cannibalization from high-end products and/or services; Resource allocation choices are greatly dependent on the forecasts of R&D projects' estimated potential contribution to cash flows;	Hueske et al. (2015); Christensen (2001); Bond & Houston (2003)
	Rewarding crisis management over proactivity	Failure often occurs even if managers are aware of need of change	Johnson (1988)
	No social incentives to pursue innovation	Innovative success is greatly dependent on the abilities of individuals who enthusticially support innovation; Tolerance to fail; Safe-to-fail culture; Innovative initiatives cause more work	Hauschildt (2003); Baer & Markus (2003); hypothesized based on interviews
	No financial incentives to pursue innovation	Financial incentives make people suggest fewer but better ideas; lack of commitment to innovation; Innovative initiatives cause more work	Torres (2015); hypothesized based on interviews
Performance			
	Organizational agility	Organizational agility answers the needs of increasingly dynamic environment; Organizational agility is enabled by sensing, searching, seizing, shifting, and shaping resource base and new capabilities	Teece et al. (2016); Baskarada & Koronius (2018)
	Visionary leaders	Appropriate leadership for innovation is depicted as *visionary* leadership	Caridi-Zahavi (2016)
	Sensitivity to technological changes	Succesfull R&D groups do not only generate innovative ideas but aim also to transfer the newly created concepts through the organizational system for economic gain	Thamhain (2003)
	Ability to learn from failures	Innovation is interactive process of learning rather than process of information exchange; Knowledge is the most crucial resource of organizations and learning is the most important process of organizations; Ability to learn from failures is key to innovative success because it also helps minimizing factors that disrupt innovation process or that hamper innovative outcomes	Lundval (2016); Chadwick & Raver (2010); Hall & Martin (2005)
	Interdepartmental linking	Multi-disciplinary view to innovation acknowledges that innovation is a reflexive and discursive process that integrates different functions and departments; Employees who are exposed to a variety of diverse sources of external knowledge are more likely to develop innovations; Departmental thought worlds affect the possible solution space due "segmentalism"; Product innovators do not often collaborate across departments	Schultz (2003); Laursen (2012); Dougherty (1992); Cooper & Kleinschmidt (1986)
	Market-technology linking	Product innovators often do not link technological and market issues	Cooper & Kleinschmidt (1986)

Appendix F: Descriptive statistics

Appendix F1: Innovation capability, descriptive statistics

Managers

	Organizational agility	Ability to learn from failing	Visionary leaders	Sensitivity to technological changes	Market-technology linking	Interdepartmental linking
N Valid	84	84	84	84	84	84
Mean	2,63	2,64	2,86	2,98	2,83	2,71
Median	3,00	3,00	3,00	3,00	3,00	3,00
Std. Deviation	1,13	1,14	1,10	,97	1,00	1,03
Range	4,00	4,00	4,00	4,00	4,00	4,00
Minimum	1,00	1,00	1,00	1,00	1,00	1,00
Maximum	5,00	5,00	5,00	5,00	5,00	5,00

Employees

	Organizational agility	Ability to learn from failing	Visionary leaders	Sensitivity to technological changes	Market-technology linking	Interdepartmental linking
N Valid	106	106	106	106	106	106
Mean	2,56	2,77	2,61	3,04	3,13	2,65
Median	3,00	3,00	3,00	3,00	3,00	3,00
Std. Deviation	1,12	1,12	1,21	1,02	,97	1,13
Range	4,00	4,00	4,00	4,00	4,00	4,00
Minimum	1,00	1,00	1,00	1,00	1,00	1,00
Maximum	5,00	5,00	5,00	5,00	5,00	5,00

Appendix F2: Innovation culture, descriptive statistics

Managers

		Our culture welcomes new ideas.	I feel encouraged to challenge decisions and actions if I think there is a better way.	I can present my ideas without fear of being judged.
N	Valid	84	84	84
Mean		3,75	3,785	3,964
Median		4,00	4,00	4,00
Std. Deviation		,91	,865	,827
Range		4,00	4,00	3,00
Minimum		1,00	1,00	2,00
Maximum		5,00	5,00	5,00
Std. Error of Mean		,10	,09	,09
Variance		,84	,75	,69
Skewness		-,63	-,70	-,58
Std. Error of Skewness		,26	,26	,26
Kurtosis		,137	,604	-,004
Std. Error of Kurtosis		,52	,52	,52

Employees

		Our culture welcomes new ideas.	I feel encouraged to challenge decisions and actions if I think there is a better way.	I can present my ideas without fear of being judged.
N	Valid	106	106	106
Mean		3,481	3,471	3,669
Median		4,00	4,00	4,00
Std. Deviation		1,05	1,15	1,09
Range		4,00	4,00	4,00
Minimum		1,00	1,00	1,00
Maximum		5,00	5,00	5,00
Std. Error of Mean		,102	,11	,11
Variance		1,11	1,32	1,18
Skewness		-,47	-,67	-1,00
Std. Error of Skewness		,23	,23	,23
Kurtosis		-,24	-,38	,50
Std. Error of Kurtosis		,46	,46	,46

Appendix G: Independent Samples Test

Appendix G1: Independent samples t-test for statistically significant differences in constructs

Independent Samples Test

Category	Construct		Levene's Test for Equality of Variances: F	Levene's Test for Equality of Variances: Sig.	t-test for Equality of Means: t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower	95% Confidence Interval of the Difference: Upper
BARRIER	Leadership barriers	Equal variances assumed	1,169	,281	-1,065	188	**,288**	**-1,02454**	,96243	-2,92310	,87401
		Equal variances not assumed			-1,078	185,132	**,282**	**-1,02454**	,95027	-2,89929	,85020
ENABLER	Culture	Equal variances assumed	6,282	,013	2,371	188	**,019**	**,87736**	,36997	,14754	1,60718
		Equal variances not assumed			2,442	187,900	**,016**	**,87736**	,35928	,16861	1,58610
BARRIER	Organizational barriers	Equal variances assumed	,142	,706	,680	188	**,498**	**,82700**	1,21706	-1,57385	3,22784
		Equal variances not assumed			,684	181,912	**,495**	**,82700**	1,20978	-1,56001	3,21401
OUTCOME	Innovation capability	Equal variances assumed	,320	,572	-,156	188	**,877**	**-,11526**	,74110	-1,57720	1,34669
		Equal variances not assumed			-,156	180,422	**,876**	**-,11526**	,73855	-1,57257	1,34206

*value in column *Mean difference* implies relative score of managers to employees (i.e. value of -1 equal one unit lower value for managers compared to employees)

Appendix G2: Independent samples t-test for statistically significant differences in constructs

Independent Samples Test

Category	Construct		Levene's Test for Equality of Variances: F	Levene's Test for Equality of Variances: Sig.	t-test for Equality of Means: t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower	95% Confidence Interval of the Difference: Upper
BARRIER	MANAGEMENT	Equal variances assumed	,033	,856	-1,802	188	**,073**	**-,95215**	,52849	-1,99468	,09038
		Equal variances not assumed			-1,805	179,498	**,073**	**-,95215**	,52745	-1,99295	,08866
BARRIER	FOCUS	Equal variances assumed	1,516	,220	-,139	188	**,890**	**-,07239**	,52220	-1,10252	,95774
		Equal variances not assumed			-,141	185,545	**,888**	**-,07239**	,51505	-1,08849	,94371
BARRIER	INCENTIVES	Equal variances assumed	1,571	,212	,752	188	**,453**	**,37895**	,50374	-,61477	1,37266
		Equal variances not assumed			,762	185,234	**,447**	**,37895**	,49725	-,60205	1,35994
BARRIER	PROCESS	Equal variances assumed	,021	,885	,422	188	**,674**	**,22323**	,52916	-,82063	1,26709
		Equal variances not assumed			,423	179,474	**,673**	**,22323**	,52815	-,81895	1,26540
BARRIER	RESOURCES	Equal variances assumed	1,323	,252	,776	188	**,439**	**,37158**	,47882	-,57297	1,31614
		Equal variances not assumed			,787	185,659	**,432**	**,37158**	,47211	-,55981	1,30298
ENABLER	culture_welcomes_new_ideas	Equal variances assumed	3,644	,058	1,849	188	**,066**	**,26887**	,14538	-,01792	,55566
		Equal variances not assumed			1,879	186,311	**,062**	**,26887**	,14307	-,01337	,55111
ENABLER	encouraged_to_challenge_decisions	Equal variances assumed	11,923	,001	2,081	188	**,039**	**,31402**	,15088	,01639	,61165
		Equal variances not assumed			2,149	187,562	**,033**	**,31402**	,14611	,02578	,60225
ENABLER	non_judgemental_climate	Equal variances assumed	7,669	,006	2,058	188	**,041**	**,29447**	,14307	,01225	,57670
		Equal variances not assumed			2,122	187,764	**,035**	**,29447**	,13875	,02077	,56818

*value in column *Mean difference* implies relative score of managers to employees (for example value of -1 equals one unit lower value for managers when compared to employees and +1 one unit greater)

Appendix G3: Independent samples t-test for statistically significant differences in survey items

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	b	Mean Difference	Std. Error Difference	Lower	Upper
ATTITUDE_exec	Equal variances assumed	1,111	,293	2,845	188	,005	,39695	,13954	,12168	,67222
	Equal variances not assumed			2,839	176,861	,005	,39695	,13981	,12104	,67286
ATTITUDE_MANAG_STAFF	Equal variances assumed	1,186	,278	1,646	188	,101	,23899	,14519	-,04742	,52541
	Equal variances not assumed			1,684	187,732	,094	,23899	,14196	-,04104	,51903
ATTITUDE_MANAG_NO_STAFF	Equal variances assumed	1,430	,233	,184	188	,854	,02446	,13271	-,23733	,28625
	Equal variances not assumed			,187	186,277	,852	,02446	,13061	-,23320	,28213
ATTITUDE_EMPLOYEE	Equal variances assumed	1,515	,220	-1,885	188	,061	-,29984	,15909	-,61368	,01399
	Equal variances not assumed			-1,856	166,024	,065	-,29984	,16156	-,61882	,01913
culture_welcomes_new_ideas	Equal variances assumed	3,644	,058	1,849	188	,066	,26887	,14538	-,01792	,55566
	Equal variances not assumed			1,879	186,311	,062	,26887	,14307	-,01337	,55111
encouraged_to_challenge_decisions	Equal variances assumed	11,923	,001	2,081	188	,039	,31402	,15088	,01639	,61165
	Equal variances not assumed			2,149	187,562	,033	,31402	,14611	,02578	,60225
non_judgemental_climate	Equal variances assumed	7,669	,006	2,058	188	,041	,29447	,14307	,01225	,57670
	Equal variances not assumed			2,122	187,764	,035	,29447	,13875	,02077	,56818
resource_reluctancy	Equal variances assumed	7,434	,007	,552	188	,582	,10085	,18282	-,25979	,46150
	Equal variances not assumed			,567	187,993	,571	,10085	,17788	-,25003	,45174
Lack_shared_vision_pur_strg	Equal variances assumed	,076	,784	-1,243	188	,215	-,19542	,15716	-,50544	,11460

	Equal variances not assumed			-1,245	178,878	,215	-,19542	,15700	-,50523	,11439
Short_terminism	Equal variances assumed	1,041	,309	1,160	188	,247	,18694	,16110	-,13086	,50474
	Equal variances not assumed			1,165	180,823	,245	,18694	,16044	-,12964	,50351
Lack_prio_dev_activity	Equal variances assumed	2,931	,089	,858	188	,392	,13611	,15869	-,17693	,44914
	Equal variances not assumed			,871	185,964	,385	,13611	,15633	-,17229	,44451
Lack_ownership	Equal variances assumed	1,096	,297	-2,653	188	,009	-,44340	,16715	-,77313	-,11366
	Equal variances not assumed			-2,665	181,059	,008	-,44340	,16640	-,77173	-,11506
Hierarchy_review_ideas	Equal variances assumed	3,849	,051	-1,128	188	,261	-,17557	,15560	-,48252	,13138
	Equal variances not assumed			-1,145	185,923	,254	-,17557	,15331	-,47802	,12688
Experts_not_valued	Equal variances assumed	,022	,882	-2,638	188	,009	-,44862	,17004	-,78405	-,11319
	Equal variances not assumed			-2,642	179,226	,009	-,44862	,16978	-,78364	-,11359
Diffic_find_specialists	Equal variances assumed	,122	,727	,504	188	,615	,08738	,17323	-,25435	,42910
	Equal variances not assumed			,502	175,518	,616	,08738	,17389	-,25580	,43056
Risk_aversion	Equal variances assumed	,101	,751	-,669	188	,504	-,10737	,16057	-,42411	,20937
	Equal variances not assumed			-,673	182,466	,502	-,10737	,15944	-,42196	,20722
Micromgmt	Equal variances assumed	,044	,835	,688	188	,492	,11544	,16774	-,21547	,44634
	Equal variances not assumed			,686	176,036	,494	,11544	,16826	-,21664	,44751
Int_process_focus	Equal variances assumed	,179	,672	1,375	188	,171	,24153	,17561	-,10488	,58795
	Equal variances not assumed			1,379	180,058	,169	,24153	,17511	-,10399	,58706
No_sys_collection_ideas	Equal variances assumed	,699	,404	1,119	188	,265	,18419	,16461	-,14053	,50891
	Equal variances not assumed			1,128	183,194	,261	,18419	,16323	-,13786	,50624
No_sys_process_ideas	Equal variances assumed	,012	,915	1,706	188	,090	,29403	,17239	-,04604	,63409
	Equal variances not assumed			1,704	177,700	,090	,29403	,17252	-,04642	,63447
Under_funding	Equal variances assumed	,307	,580	,225	188	,822	,03567	,15859	-,27718	,34851
	Equal variances not assumed			,223	173,253	,824	,03567	,15967	-,27948	,35081

Focus_past_success	Equal variances assumed	,822	,366	-1,124	188	,263	-,20002	,17798	-,55111	,15108
	Equal variances not assumed			-1,133	183,239	,259	-,20002	,17647	-,54820	,14816
Incentives_not_rward_innov	Equal variances assumed	,037	,848	,982	188	,328	,14676	,14952	-,14820	,44172
	Equal variances not assumed			,983	179,309	,327	,14676	,14927	-,14780	,44132
No_financial_incent	Equal variances assumed	,113	,737	,628	188	,531	,09783	,15569	-,20929	,40495
	Equal variances not assumed			,630	180,376	,529	,09783	,15516	-,20834	,40400
No_social_incent	Equal variances assumed	3,722	,055	,664	188	,507	,10795	,16246	-,21253	,42843
	Equal variances not assumed			,680	187,730	,498	,10795	,15884	-,20540	,42130
Rewarding_crisis_mgmt_over_proact	Equal variances assumed	,249	,619	,175	188	,861	,02641	,15077	-,27101	,32382
	Equal variances not assumed			,176	180,425	,861	,02641	,15025	-,27007	,32288
Reluctancy_others_help	Equal variances assumed	1,636	,202	-,405	188	,686	-,06185	,15288	-,36344	,23974
	Equal variances not assumed			-,409	184,774	,683	-,06185	,15108	-,35992	,23622
Constant_shift_prio	Equal variances assumed	1,883	,172	,629	188	,530	,09860	,15676	-,21064	,40783
	Equal variances not assumed			,637	184,902	,525	,09860	,15487	-,20693	,40413
Inefficient_recruit_proc	Equal variances assumed	3,333	,069	1,441	188	,151	,23913	,16596	-,08825	,56650
	Equal variances not assumed			1,415	163,730	,159	,23913	,16896	-,09450	,57276
Psychologic_unsafety	Equal variances assumed	,163	,686	-1,464	188	,145	-,24299	,16596	-,57038	,08440
	Equal variances not assumed			-1,479	184,089	,141	-,24299	,16427	-,56708	,08109
Lack_understanding_cust	Equal variances assumed	,133	,716	,024	188	,981	,00382	,16036	-,31253	,32016
	Equal variances not assumed			,024	174,508	,981	,00382	,16119	-,31432	,32195
Lack_innovative_ideas	Equal variances assumed	2,896	,090	-,483	188	,630	-,07817	,16178	-,39730	,24096
	Equal variances not assumed			-,490	185,290	,625	-,07817	,15967	-,39316	,23683
Lack_extn_cooperation	Equal variances assumed	,063	,802	-,378	188	,706	-,05873	,15546	-,36539	,24794
	Equal variances not assumed			-,378	178,205	,706	-,05873	,15546	-,36550	,24805
Lack_sponsors	Equal variances assumed	,087	,769	,485	188	,628	,07180	,14808	-,22032	,36392

	Equal variances not assumed			,488	181,868	,626	,07180	,14721	-,21865	,36226
Lack_time	Equal variances assumed	6,156	,014	,995	188	,321	,16311	,16390	-,16021	,48643
	Equal variances not assumed			1,017	187,557	,311	,16311	,16044	-,15339	,47962
Lack_dev_personnel	Equal variances assumed	,488	,486	,623	188	,534	,10101	,16226	-,21907	,42109
	Equal variances not assumed			,626	181,986	,532	,10101	,16127	-,21718	,41920
Lack_compet_personnel	Equal variances assumed	4,552	,034	1,904	188	,058	,34242	,17988	-,01243	,69727
	Equal variances not assumed			1,926	184,678	,056	,34242	,17781	-,00837	,69322
Lack_skillful_brainstorm_facilt	Equal variances assumed	,906	,342	-,555	188	,580	-,08814	,15895	-,40169	,22541
	Equal variances not assumed			-,558	181,722	,578	-,08814	,15805	-,39999	,22371
No_forums_for_discussion	Equal variances assumed	,994	,320	-1,040	188	,300	-,16685	,16048	-,48342	,14973
	Equal variances not assumed			-1,048	183,199	,296	-,16685	,15914	-,48082	,14713
Super_Manag_no_listen	Equal variances assumed	5,086	,025	-1,992	188	,048	-,33356	,16747	-,66392	-,00319
	Equal variances not assumed			-2,037	187,732	,043	-,33356	,16374	-,65657	-,01055
Super_Manager_no_understand	Equal variances assumed	1,801	,181	-2,712	188	,007	-,43486	,16034	-,75116	-,11856
	Equal variances not assumed			-2,764	187,074	,006	-,43486	,15735	-,74526	-,12446
Results_expected_sooner_realistic	Equal variances assumed	1,329	,250	,821	188	,413	,12909	,15721	-,18103	,43921
	Equal variances not assumed			,828	183,217	,409	,12909	,15588	-,17847	,43665
Perf_agility	Equal variances assumed	,005	,941	,394	188	,694	,06491	,16491	-,26040	,39023
	Equal variances not assumed			,393	176,997	,695	,06491	,16520	-,26110	,39093
Perf_ability_to_learn	Equal variances assumed	,188	,665	-,828	188	,409	-,13705	,16548	-,46349	,18939
	Equal variances not assumed			-,826	176,314	,410	-,13705	,16593	-,46451	,19041
Perf_positive_attitude	Equal variances assumed	,958	,329	,927	188	,355	,15094	,16283	-,17026	,47215
	Equal variances not assumed			,934	182,593	,352	,15094	,16165	-,16800	,46989
Per_collaborative_cult	Equal variances assumed	2,111	,148	-,074	188	,941	-,01190	,16192	-,33132	,30751
	Equal variances not assumed			-,075	185,416	,941	-,01190	,15976	-,32708	,30327

Perf_visionary_leaders	Equal variances assumed	3,393	,067	1,480	188	,140	,25244	,17052	-,08394	,58883
	Equal variances not assumed			1,496	184,300	,136	,25244	,16870	-,08039	,58527
Perf_safe_to_fail	Equal variances assumed	,107	,745	-,337	188	,736	-,06379	,18911	-,43684	,30926
	Equal variances not assumed			-,341	183,833	,734	-,06379	,18728	-,43328	,30570
Perf_flexible_tools	Equal variances assumed	,049	,825	-,783	188	,435	-,14600	,18649	-,51388	,22187
	Equal variances not assumed			-,786	180,358	,433	-,14600	,18586	-,51275	,22075
Perf_superior_tech_comp	Equal variances assumed	2,186	,141	1,575	188	,117	,24304	,15428	-,06130	,54738
	Equal variances not assumed			1,596	185,216	,112	,24304	,15230	-,05742	,54349
Perf_sensitivity_tech_chg	Equal variances assumed	,651	,421	-,395	188	,693	-,05804	,14677	-,34756	,23148
	Equal variances not assumed			-,398	181,914	,691	-,05804	,14589	-,34589	,22981
Perf_market_tech_linkg	Equal variances assumed	,360	,549	-2,078	188	,039	-,30017	,14443	-,58508	-,01526
	Equal variances not assumed			-2,072	175,959	,040	-,30017	,14489	-,58612	-,01422
Perf_interdep_linkg	Equal variances assumed	,806	,371	,393	188	,695	,06265	,15932	-,25164	,37694
	Equal variances not assumed			,397	184,326	,691	,06265	,15761	-,24831	,37360

*value in column *Mean difference* implies relative score of managers to employees (for example value of -1 equals one unit lower value for managers when compared to employees and +1 one unit greater)

Appendix H: Mean values for survey items across groups

Appendix H1: Mean values for survey item 1

	POSITION	N	Mean	Std. Deviation	Std. Error Mean
ATTITUDE_exec	1,00 Managerial position with staff responsibilities	84	3,5217	,96412	,10519
	3,00 Non-managerial position	106	3,1247	,94817	,09209
ATTITUDE_MANAG_STAFF	1,00 Managerial position with staff responsibilities	84	3,3333	,88268	,09631
	3,00 Non-managerial position	106	3,0943	1,07374	,10429
ATTITUDE_MANAG_NO_STAFF	1,00 Managerial position with staff responsibilities	84	3,2631	,83731	,09136
	3,00 Non-managerial position	106	3,2386	,96103	,09334
ATTITUDE_EMPLOYEE	1,00 Managerial position with staff responsibilities	84	2,9018	1,16795	,12743
	3,00 Non-managerial position	106	3,2016	1,02247	,09931
culture_welcomes_new_ideas	1,00 Managerial position with staff responsibilities	84	3,7500	,91671	,10002
	3,00 Non-managerial position	106	3,4811	1,05317	,10229
encouraged_to_challenge_decisions	1,00 Managerial position with staff responsibilities	84	3,7857	,86528	,09441
	3,00 Non-managerial position	106	3,4717	1,14815	,11152
non_judgemental_climate	1,00 Managerial position with staff responsibilities	84	3,9643	,82792	,09033
	3,00 Non-managerial position	106	3,6698	1,08427	,10531
resource_reluctancy	1,00 Managerial position with staff responsibilities	84	3,4405	1,07939	,11777
	3,00 Non-managerial position	106	3,3396	1,37243	,13330
Lack_shared_vision_pur_strg	1,00 Managerial position with staff responsibilities	84	3,2857	1,07065	,11682
	3,00 Non-managerial position	106	3,4811	1,07996	,10489
Short_terminism	1,00 Managerial position with staff responsibilities	84	3,8452	1,08099	,11795
	3,00 Non-managerial position	106	3,6583	1,11983	,10877
Lack_prio_dev_activity	1,00 Managerial position with staff responsibilities	84	3,5899	1,00645	,10981
	3,00 Non-managerial position	106	3,4538	1,14550	,11126
Lack_ownership	1,00 Managerial position with staff responsibilities	84	3,0000	1,11938	,12213
	3,00 Non-managerial position	106	3,4434	1,16358	,11302

Hierarchy_review_ideas	1,00 Managerial position with staff responsibilities	84	3,1995	,98754	,10775
	3,00 Non-managerial position	106	3,3751	1,12282	,10906
Experts_not_valued	1,00 Managerial position with staff responsibilities	84	2,5089	1,15543	,12607
	3,00 Non-managerial position	106	2,9575	1,17081	,11372
Diffic_find_specialists	1,00 Managerial position with staff responsibilities	84	3,0119	1,20735	,13173
	3,00 Non-managerial position	106	2,9245	1,16862	,11351
Risk_aversion	1,00 Managerial position with staff responsibilities	84	3,0736	1,06181	,11585
	3,00 Non-managerial position	106	3,1809	1,12784	,10955
Micromgmt	1,00 Managerial position with staff responsibilities	84	3,2262	1,16527	,12714
	3,00 Non-managerial position	106	3,1108	1,13475	,11022
Int_process_focus	1,00 Managerial position with staff responsibilities	84	3,5301	1,18563	,12936
	3,00 Non-managerial position	106	3,2886	1,21504	,11802
No_sys_collection_ideas	1,00 Managerial position with staff responsibilities	84	3,5238	1,08079	,11792
	3,00 Non-managerial position	106	3,3396	1,16199	,11286
No_sys_process_ideas	1,00 Managerial position with staff responsibilities	84	3,4167	1,18432	,12922
	3,00 Non-managerial position	106	3,1226	1,17678	,11430
Under_funding	1,00 Managerial position with staff responsibilities	84	3,3261	1,12057	,12226
	3,00 Non-managerial position	106	3,2905	1,05726	,10269
Focus_past_success	1,00 Managerial position with staff responsibilities	84	3,2381	1,16804	,12744
	3,00 Non-managerial position	106	3,4381	1,25678	,12207
Incentives_not_rward_innov	1,00 Managerial position with staff responsibilities	84	3,5716	1,01536	,11079
	3,00 Non-managerial position	106	3,4248	1,03003	,10005
No_financial_incent	1,00 Managerial position with staff responsibilities	84	3,3650	1,04849	,11440
	3,00 Non-managerial position	106	3,2672	1,07926	,10483
No_social_incent	1,00 Managerial position with staff responsibilities	84	3,2929	,98773	,10777
	3,00 Non-managerial position	106	3,1849	1,20141	,11669
Rewarding_crisis_mgmt_over_proact	1,00 Managerial position with staff responsibilities	84	3,5165	1,01496	,11074

	3,00 Non-managerial position	106	3,4901	1,04549	,10155
Reluctancy_others_help	1,00 Managerial position with staff responsibilities	84	3,2738	,98606	,10759
	3,00 Non-managerial position	106	3,3357	1,09207	,10607
Constant_shift_prio	1,00 Managerial position with staff responsibilities	84	3,5714	1,00942	,11014
	3,00 Non-managerial position	106	3,4728	1,12092	,10887
Inefficient_recruit_proc	1,00 Managerial position with staff responsibilities	84	3,4576	1,23175	,13439
	3,00 Non-managerial position	106	3,2185	1,05432	,10240
Psychologic_unsafety	1,00 Managerial position with staff responsibilities	84	2,7729	1,07923	,11775
	3,00 Non-managerial position	106	3,0158	1,17918	,11453
Lack_understanding_cust	1,00 Managerial position with staff responsibilities	84	3,1548	1,12469	,12271
	3,00 Non-managerial position	106	3,1509	1,07608	,10452
Lack_innovative_ideas	1,00 Managerial position with staff responsibilities	84	2,7143	1,03634	,11307
	3,00 Non-managerial position	106	2,7925	1,16060	,11273
Lack_extn_cooperation	1,00 Managerial position with staff responsibilities	84	3,1125	1,06423	,11612
	3,00 Non-managerial position	106	3,1712	1,06420	,10336
Lack_sponsors	1,00 Managerial position with staff responsibilities	84	3,2860	,98469	,10744
	3,00 Non-managerial position	106	3,2142	1,03610	,10063
Lack_time	1,00 Managerial position with staff responsibilities	84	3,9273	1,00341	,10948
	3,00 Non-managerial position	106	3,7642	1,20753	,11729
Lack_dev_personnel	1,00 Managerial position with staff responsibilities	84	3,4167	1,07780	,11760
	3,00 Non-managerial position	106	3,3157	1,13614	,11035
Lack_compet_personnel	1,00 Managerial position with staff responsibilities	84	3,0217	1,16160	,12674
	3,00 Non-managerial position	106	2,6792	1,28395	,12471
Lack_skillful_brainstorm_facilt	1,00 Managerial position with staff responsibilities	84	3,1571	1,05833	,11547
	3,00 Non-managerial position	106	3,2453	1,11108	,10792
No_forums_for_discussion	1,00 Managerial position with staff responsibilities	84	3,2143	1,05364	,11496
	3,00 Non-managerial position	106	3,3811	1,13289	,11004

Super_Manag_no_listen	1,00 Managerial position with staff responsibilities	84	2,3929	1,01812	,11109
	3,00 Non-managerial position	106	2,7264	1,23853	,12030
Super_Manager_no_understand	1,00 Managerial position with staff responsibilities	84	2,4048	,99540	,10861
	3,00 Non-managerial position	106	2,8396	1,17219	,11385
Results_expected_sooner_realistic	1,00 Managerial position with staff responsibilities	84	3,4638	1,03196	,11260
	3,00 Non-managerial position	106	3,3347	1,10993	,10781
Perf_agility	1,00 Managerial position with staff responsibilities	84	2,6310	1,13838	,12421
	3,00 Non-managerial position	106	2,5660	1,12138	,10892
Perf_ability_to_learn	1,00 Managerial position with staff responsibilities	84	2,6429	1,14747	,12520
	3,00 Non-managerial position	106	2,7799	1,12111	,10889
Perf_positive_attitude	1,00 Managerial position with staff responsibilities	84	3,0000	1,07547	,11734
	3,00 Non-managerial position	106	2,8491	1,14470	,11118
Per_collaborative_cult	1,00 Managerial position with staff responsibilities	84	2,9881	1,03544	,11298
	3,00 Non-managerial position	106	3,0000	1,16292	,11295
Perf_visionary_leaders	1,00 Managerial position with staff responsibilities	84	2,8690	1,10617	,12069
	3,00 Non-managerial position	106	2,6166	1,21351	,11787
Perf_safe_to_fail	1,00 Managerial position with staff responsibilities	84	2,7381	1,23326	,13456
	3,00 Non-managerial position	106	2,8019	1,34107	,13026
Perf_flexible_tools	1,00 Managerial position with staff responsibilities	84	2,5238	1,25608	,13705
	3,00 Non-managerial position	106	2,6698	1,29263	,12555
Perf_superior_tech_comp	1,00 Managerial position with staff responsibilities	84	3,7619	,98933	,10794
	3,00 Non-managerial position	106	3,5189	1,10610	,10743
Perf_sensitivity_tech_chg	1,00 Managerial position with staff responsibilities	84	2,9876	,97554	,10644
	3,00 Non-managerial position	106	3,0457	1,02718	,09977
Perf_market_tech_linkg	1,00 Managerial position with staff responsibilities	84	2,8319	1,00381	,10952
	3,00 Non-managerial position	106	3,1321	,97664	,09486
Perf_interdep_linkg	1,00 Managerial position with staff responsibilities	84	2,7155	1,03321	,11273

	3,00 Non-managerial position	106	2,6528	1,13404	,11015

*value in column *Mean difference* implies relative score of managers to employees (i.e. value of -1 equal one unit lower value for managers compared to employees)